

## **Organoleptic Test and Iron Level Test Tofu Moringa meatballs as an alternative snack for Teenage Girls**

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### **ABSTRACT**

Many teenage girls in Indonesia suffer from anemia, prompting exploration into alternative dietary interventions. Moringa leaves, known for their high iron content, offer a potential solution. This study aimed to formulate tofu meatballs enriched with moringa flour, evaluating their iron content and organoleptic qualities as a feasible iron supplement for adolescent girls. Three tofu meatball formulations were tested: F1B with no added moringa flour, F2B with 5 g, and F3B with 10 g. Iron content was assessed using ICP-OES, and organoleptic tests were conducted. Statistical analysis included the Kruskal-Wallis test, with Mann-Whitney test for significant differences. Results revealed F2B had the highest iron content at 1.34 mg/100 g, followed by F1B at 1.06 mg/100 g, and F3B at 1.23 mg/100 g. However, iron levels per serving fell short of the 10% daily requirement. While F1B was preferred for taste, aroma, color, and texture, F2B and F3B were still acceptable. Future improvements could involve using boiled moringa leaves and seasoning to enhance organoleptic qualities.

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### **INTRODUCTION**

Nutritional problems in Indonesia involve various age groups in line with the phenomenon of the ongoing life cycle. The adolescent phase is a transitional phase that connects preadolescence to adulthood. In this period there are many who experience anemia, to overcome the problem of anemia in adolescent girls must be treated quickly because it has an impact on the number of maternal mortalities, the high incidence of babies with low birth weight, and the increase in the number of prenatal mortalities.<sup>1</sup>

Based on data collected from Basic Health Research in 2018, there was a significant increase of 48.9% in the prevalence of anemia in adolescent girls, compared to a rate of 37.1% in 2013. Anemia is a condition where Hemoglobin (Hb) is lower than it should be for normal Hb levels in women 12 g / dL and men 13 g / dL.<sup>2</sup> Anemia induces a state in which hemoglobin is unable to combine and obtain adequate oxygen from the respiratory organs to the rest of the body.<sup>3</sup>

Some of the factors that cause anemia in adolescent girls are intake, energy, protein intake, iron intake, vitamin C intake, tea or coffee drinking habits, level of knowledge, education, income and employment of parents. Symptoms of anemia include headache, fatigue, fatigue, blurry vision, loss of appetite, physical decline, duration of wound healing.<sup>4</sup>

The presence of iron is very important in the process of monoamine synthesis, energy metabolism, myelination, neurotransmitter cyst, and dopamine metabolism. Found in animal foods

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has greater potential due to absorption rates of 20-30% greater ability to absorb iron without food additives.<sup>5</sup> The maintenance of adolescent health to prevent anemia can be realized through preventive measures that involve the consumption of adequate nutrients in the form of iron, which can be obtained from foods with the necessary content of animal protein, vegetable protein and vitamin C. It is recommended that teenagers eat foods consisting of red meat, fish, eggs, and types of green vegetables such as spinach, kale, and other types in meeting iron needs.<sup>6</sup>

One of the foods that has the potential as iron fortification food that can be used in Indonesia is Moringa leaves. In 100 grams of Moringa leaves contain 6 mg of iron, while in 200 grams of fresh meat contains 5.8 grams of iron. Moringa leaf powder as much as 50 grams has an iron content of 94%, which is safe for use by pregnant women.<sup>7</sup> One of the most requested foods for young women is meatball tofu. Tofu meatballs are light dish tofu meatballs are a reliable alternative As a source of plant and animal protein, considering that both consist of protein-containing components in tofu as a source of plant protein and meat as a source of animal protein. Tofu meatballs added with moringa flour are a very suitable choice to be used as an iron complementary food that can be used as a snack for teenagers.<sup>8</sup> Based on the context presented, researchers expressed interest in investigating the potential of meatballs with the addition of moringa flour as an alternative food option rich in iron for adolescent girls. The general purpose of this study was to determine the formulation of meatball tofu involving the incorporation of moringa leaf flour as an additive and analyze its effect on iron content and test the organoleptic properties of meatball tofu as a complementary food choice rich in iron for young women.

## **MATERIALS AND METHODS**

This type of research uses experimental methods. This research for iron level tests was carried out at the Saraswanti Indo Genetech Laboratory and organoleptic tests were carried out at the Laboratory of the Department of Nutrition Poltekkes Kemenkes Surabaya. The time for this research is November 2022 – June 2023. Panelists used as many as 25 Surabaya poltekkes nutrition students. In this study there were 3 samples of 1 control formulation and 2 formulation with the addition of Moringa leaf flour.

To determine the iron content in Moringa Meatball Tofu using the ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry) method Analysis of the iron content of the sample was carried out by ICP-OES spectrophotometer test with 1 control and 2 treatments, by adding Moringa leaf flour with different doses, namely 0 grams, 5 grams, 10 grams with 2 repetitions and if there is a difference then further tests are carried out.

The acceptability test results involving taste, aroma, color, and texture were tested using the Kruskal-Wallis's test method to determine the product most preferred by the test participant with an

error rate of 0.05 ( $\alpha = 0.05$ ) as a basis. If differences are found between these products, it is necessary to do a post-hoc test with the Mann-Whitney test to find out whether the difference is significant with a confidence level of  $p < 0.05$ .

## RESULTS

**Table 1. Characteristics of Tofu Meatballs with the Addition of Moringa Leaf Flour**

Indicator	Meatball Tofu Formulation		
	F1B	F2B	F3B
Color	Cream	Greenery	Dark green
Taste	Savory, salty	Salty, savory, slightly pronounced moringa leaf flour	Salty, savory, tasted moringa leaf flour
Aroma	Special aromas know meatballs	The distinctive aroma of tofu, meatballs and moringa leaves	The distinctive aroma of tofu, meatballs and moringa leaves
Texture	Chewy	Chewy, slightly dense	Slightly chewy, denser

Source: Primary Data, 2023

**Table 1. Average Value of Moringa Meatball Tofu Formulation Assessment**

No.	Indicator	Meatball Tofu Formulation		
		F1B	F2B	F3B
1.	Color	4.08	4.16	3.44
2.	Taste	4.24	3.8	3.8
3.	Aroma	4.36	3.52	3.44
4.	Tekstur	4.04	3.68	3.52
	Average	4.18	3.79	3.55

Source: Primary Data, 2023

Based on the results of organoleptic tests as a whole in terms of color, taste, aroma and texture table above of the three formulations of Moringa meatball tofu that are widely preferred, namely formulation F1B with a score of 4.18 is included in the likes category, for the formulation of adding Moringa leaf flour is most preferred in the F2B formulation with a score of 3.79 is included in the neutral category.

**Table 2. Kruskal Wallis Test Results Know Meatballs**

No.	Indicator	Wallis Kruskal Test Value
1.	Color	0.014
2.	Taste	0.123
3.	Aroma	0.001
4.	Tekstur	0.217

Based on the table above that the color and aroma indicators have significant differences due to the results of  $p < 0.05$ .

**Table 4. Hasil Uji Mann Whitney**

No.	Indicator	Moringa Meatball Tofu	Mann Whitney Score
1.	Color	F1B with F2B	0.707
		F1B with F3B	0.019
		F2B with F3B	0.008
2.	Aroma	F1B with F2B	0.001
		F1B with F3B	0.001
		F2B with F3B	0.832

Based on the table above, the mann whiteneiy test, namely on the color indicator formula F1B with F3B and F2B with F3B there is a noticeable difference ( $p < 0.05$ ). In the aroma indicators of the formula F1B with F2b and F1B with F3B there is a noticeable difference ( $p < 0.05$ ).

**Table 5. Iron content in tofu meatballs with the addition of Moringa leaf flour 100 g**

No.	Code	Until Zat Besi Simplo (mg/100 g)	Up to Zat Besi Duplo (mg/100g)	Average (mg/100 g)
1.	F1B	1.06	1.05	1.055
2.	F2B	1.34	1.32	1.33
3.	F3B	1.23	1.22	1.22

Based on the table above, the results of iron levels in Moringa meatball tofu are the highest iron levels in the F2B formula of 1.34mg / 100 g with a dose of 5 grams of Moringa leaf flour

## DISCUSSION

### Organoleptic characteristics of meatball tofu with the addition of moringa leaf flour

In the formulation of meatball tofu plus moringa leaf flour in the F2B and F3B formulations. The processing of meatball tofu consists of various ingredients, namely: tapioca flour, chicken, eggs, fried onions, garlic, pepper, corn pills, sugar, salt, sesame oil, tofu pong, leeks, moringa leaf flour. Organoleptic tests are very necessary in this study because the results of organoleptic tests determine whether or not the product is accepted in the community or consumers. The higher the value of the level of liking for the product, the greater the value of the opportunity for the product to be accepted by the public or consumers. The parameters used to assess the level of liking for meatball tofu include color, taste, aroma, and texture then the assessment of the level of liking was carried out by 25 trained palenists from students majoring in Nutrition at the Health Polytechnic of the Ministry of Health Surabaya.

## **Color**

Color is an aspect that influences consumer decisions in choosing products. Usually, panelists assessing the quality of food ingredients are generally the first to be seen using color as a determinant of food ingredient assessment considerations.<sup>9</sup> Attractive colors are usually preferred by consumers. Based on the results of organoleptic tests, the most preferred color formulation is the F2B formulation with a value of 4.16, which is included in the "like" category. This formulation contains the addition of 5 g of moringa leaf flour with a greenish tint. Other studies are also in line with other researchers that acceptability decreases along with the addition of the amount of Moringa leaf flour given, because more and more Moringa leaf flour produces a dark green color.<sup>10</sup> In Moringa leaf flour, there is chlorophyll pigment or green leaf substance that gives it a green color. Chlorophyll is a compound found in Moringa leaves.<sup>11</sup>

## **Taste**

Taste is one of the most significant factors in evaluating food to be accepted by consumers.<sup>12</sup> From these results, the formula that gets the most preference is the F1B formula with a score of 4.24 which is included in the like category, but Moringa meatball tofu in the F2B and F3B flavor formulations is still accepted by panelists because the score results are in the neutral category. The number of Moringa leaves added to meatball tofu results in an increase in the bitter taste of meatball tofu. Research findings by Indriasari stated that the addition of the number of Moringa leaves in biscuit flour caused a decrease in the acceptance rate of panelists due to the bitter and bitter taste.<sup>13</sup> True, the bitter taste in essential oils or essential oils is usually due to the presence of terpenoid compounds. Essential oils are mixtures of chemical compounds produced by plants and have a distinctive aroma from these plants.

Moringa leaves contain terpenoid compounds which are most of the constituents of essential oil components produced by these leaves. These terpenoid compounds give a distinctive aroma and taste that generally has a bitter character. In addition, terpenoid compounds also play a role in giving essential oils other properties, such as antimicrobial, antioxidant, and anti-inflammatory properties. The use of essential oils from Moringa leaves has been known for a long time in various applications, including in the food industry, beverages, and also in traditional medicine.<sup>23</sup>

## **Aroma**

The sensory perception of aroma in food affects the sensory assessment of aroma in that food. A dish will be preferred by consumers if it has a unique aroma and invites interest.<sup>14</sup> The aroma of F1B formula meatball tofu is most preferred because the aroma is not langu. In the F1B formula, there is no addition of Moringa leaf flour. The aroma will increase langu typical of Moringa leaf aroma as Moringa leaf flour increases. The increasingly strong langu aroma decreased the

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panelists' favorability.<sup>25</sup> The cause of the unpleasant aroma in meatball tofu is the presence of saponin compounds contained in Moringa leaves. Saponins are a type of steroid compound / triterpenoid glucoside bound to carbohydrates.<sup>15</sup>

## **Texture**

Assessment of food texture can be done with fingers, teeth and palate. The value obtained is expected to determine the quality of food. Texture factors include palpation by hand, tenderness and ease when chewed.<sup>16</sup> Assessment of the texture of meatball tofu with the addition of Moringa leaf flour from the results of organoleptic tests on three formulations, the most preferred formula is the texture formula F1B with a value of 4.04 which is included in the category of like. The formulation that is more dosed, namely F3B, has a harder texture because there will be more reactions between water and the flour and form a gel, with the carbohydrate content of Moringa leaf flour playing a role in forming the dough structure. The cause of the harder texture in Moringa leaf powder can be attributed to the protein content contained in the powder. According to research conducted by Pramesti in 2019, proteins in Moringa leaf powder can form complex bonds with starch and granule surfaces, leading to a decrease in the viscosity and strength of the gel. As a result, the texture of Moringa leaf powder becomes harder.

Protein in foods such as Moringa leaves has an important role in shaping the structure and texture of the final product. When proteins interact with starch (carbohydrates) and other granule surfaces, it can cause changes in the structure of the product, including increased hardness or stiffness of the product. These changes can also affect the organoleptic characteristics and functional properties of Moringa leaf powder, such as viscosity and gel strength.

The results of this research are important to understand the properties of food ingredients and can be used to optimize the production process and improve the quality of the final product from Moringa leaf powder.<sup>24</sup> This phenomenon is what causes meatball tofu to have a dense texture. The dough will become denser as you add more moringa flour.<sup>17</sup> However, all formulas are still acceptable to panelists because they fall into the likes and neutral categories.

## **Reasons for Adding Sweet Corn in Tofu, Meatballs and Intercorrelation of Phytate and Iron**

The first reason researchers added sweet corn was to improve the bitter and langu taste of meatball tofu because the taste of corn helped disguise the taste of moringa flour. The bitter taste is caused due to the content of tannins, saponins and pitic acid.<sup>22</sup> But it turns out that in the content of sweet corn there are phytates. Phytic acid in vegetables inhibits iron absorption.<sup>21</sup> Therefore, for the addition of corn is better not to add.

## **Iron levels in tofu meatballs with the addition of moringa leaf flour**

The results of iron content analysis on F1B meatball tofu amounted to 0.69 mg per serving, for F2B of 0.87 mg per serving and F3B meatball tofu of 0.80 mg per serving. The need for interlude in a day in adolescent girls is 210 Kcal and iron 1.5 mg. This shows that one serving of meatball tofu has not met the needs of a day's snacks. The value of iron levels in nutrisurvey and laboratory results is different, the results from the laboratory are smaller than the value of F2B iron levels, while the dose of F3B Moringa leaf flour is more. A decrease in iron concentration in meatball tofu may occur because the raw material undergoes a processing process. Moringa leaf flour has an iron content that is 25 times higher than spinach, with iron levels of 28.2 mg per 100 g. Moringa leaves also have potential as an alternative treatment because they are proven to contain various antioxidant compounds.<sup>18</sup>

The value of iron levels in nutrisurvey and laboratory results is different, the results from the laboratory are smaller than the value of F2B iron levels, while the dose of F3B Moringa leaf flour is more. A decrease in iron concentration in meatball tofu may occur because the raw material undergoes a processing process.<sup>19</sup> High temperatures and long steaming also reduce iron levels; this is also agreed by other researchers that the higher the steaming temperature the lower iron levels.<sup>20</sup>

## **Combination of Iron and the Best Organoleptic Results**

The best iron content results were obtained in the F2B formula, namely with the addition of 5 grams of Moringa leaf flour, iron value of 1.34 mg / 100 g. The most preferred organoleptic test result is the F1B formula, which is a control formula with 0 g of added moringa leaf flour. The organoleptic test results of panelists prefer the control formula because the F1B formula has a salty and savory taste only while the F2B and F3B formulas are preferred slightly because there is a taste of Moringa leaf flour. (reason for moringa bitter taste).<sup>21</sup> Although the results of the F1B organoleptic test are most preferred, F2B and F3B are still accepted by the panelists because the results are still relatively neutral.

## **CONCLUSION**

Based on the research and experiments conducted, the results indicate that the F2B formulation has the highest iron content in meatball tofu with the addition of moringa flour, amounting to 1.34 mg/100 g. However, in terms of organoleptic properties, the F1B formulation obtained the highest scores in terms of taste, aroma, color, and texture. Nevertheless, F2B and F3B are still acceptable to the panelists as their scores fall within the neutral category. There are significant differences in the color indicator between the F1B and F3B formulas, and between F2B

and F3B. Similarly, significant differences exist in the aroma indicator between the F1B and F2B formulas, and between F1B and F3B.

However, it is important to note that this conclusion only describes specific aspects of this research. Further implications of these findings may include improving meatball tofu formulations to enhance iron content, developing processing techniques that maintain good organoleptic properties, and further investigating the effectiveness of consuming moringa-based meatball tofu in addressing anemia in adolescents. Therefore, it is recommended for further research to explore the use of additional ingredients or processing techniques that can increase iron content while maintaining organoleptic quality, and to conduct further studies on the impact of regular consumption of moringa-based meatball tofu on adolescent health, particularly in addressing anemia issues

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