Acceptability of Modified Onion Stick with Mocaf and Moringa Leaf Flour as Functional Food for Anemic Adolescent Girls

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Abstract. Adolescent girls tend to be at greater risk of developing anemia compared to adolescent boys. The background is because adolescent girls have menstruation every month, but it is not accompanied by the addition of iron-rich food intake. In an effort to meet the iron needs of them, it can be done by utilizing local food products, such as mocaf flour, and moringa leaf flour. This study aims to analyze the acceptance of onion stick that have been modified into three treatments. The research design was Completely Randomized Design (CRD), using three treatments, with a comparison of mocaf flour and moringa leaf flour, namely A1 (40:4), A2 (45:5), A3 (50:6). The data were analyzed by the Kruskal Wallis statistical test, then further analyzed by the Mann-Whitney test to see whether there was a difference. The results of the organoleptic test assessment showed that there were significant differences in the parameters of color (p = 0.001), aroma (p = 0.017), taste (p = 0.000) and texture (p = 0.003) of onion stick A1, A2, and A3, the results of the Mann Whitney test showed that the A1 formula was significantly different from the A2 and A3 formulas (p<0.05). In conclusion, the onion sticks formula A1 has the best acceptability, making it possible to conduct further research on the nutritional content and its effect on the hemoglobin level of anemic adolescent girls.

1. Introduction

In terms of meeting the iron nutritional needs of adolescent girls, this can be done by utilizing local food products that are rich in iron. Some local food products that are rich in iron are mocaf flour, and moringa leaves, both of which can be used to solve the problem of anemia in adolescent girls [1]. Mocaf or more familiarly called mocaf flour is the result of fermentation of cassava, which in the manufacturing process utilizes microbes. Mocaf itself in 100 grams has a Fe content of 15.8 mg [2]. In an effort to reduce the amount of wheat imports in Indonesia, mocaf flour can be used as a solution, because mocaf flour is made from cassava which is a local food product found throughout Indonesia. The benefits of mocaf flour are the availability of raw materials that are very abundant throughout Indonesia which will avoid the unavailability of raw materials, and can apply food self-sufficiency efforts which are government programs [3]. The high iron content in mocaf flour can be used to solve the problem of anemia.

In 100 grams of moringa leaf flour contains 28.2 mg of Fe [4]. In other studies, moringa leaves can be processed into liquid form, for example in the form of extraction, processing in the form of tea [1], processing into juice form [5] or processing in the form of brownies [6] and has been shown to be able to increase the Hb levels of adolescent girls. The educational intervention for processing moringa leaves into capsules is proven to significantly increase the Hb levels of adolescent girls, with mean and the
standard deviation is $1.76 \pm 0.80\, \text{g/dL}$ [7]. A research report was shown that the provision of modified sweet potato flour and moringa leaf flour was proven to significantly increase the Hb level of pregnant women during the 2 weeks of intervention with a $p$ value of 0.001. Giving cookies was able to increase the Hb level of pregnant women from $9.766 \pm 1.189\, \text{gr}\%$ to $10.466 \pm 1.362\, \text{gr}\%$. With an average increase in Hb levels of $0.700 \pm 1.183\, \text{gr}\%$ [8].

In previous studies, moringa leaves were processed into liquid form, but to process moringa leaves into materials that have a longer shelf life, they can be processed into dry products [9]. Onion stick are one way to process moringa leaves into a dry form. The processing of these two materials into onion stick can increase the shelf life, and is more flexible, because it is easy to carry anywhere because of its small size, and the manufacturing process tends to be easier and does not require a long time [10].

2. Materials and Method
This type of experimental research used a completely randomized design (CRD), which consisted of three treatments (A1, A2, and A3). Acceptance test in this study used 30 adolescent girls aged 12-15 years. The characteristics of the acceptability test are in the form of color, aroma, taste and texture. To obtain the total percentage of preference level, it was analyzed using Ms. Excel, to see whether there was a difference in A1, A2, and A3 onion stick analyzed with the Kruskall Wallis test and continued with the Mann Whitney test.

The ingredients used include wheat flour, tapioca flour, mocaf flour, moringa leaf flour, eggs, shallots, garlic, margarine, salt, powdered broth and cooking oil. Comparison formulation of wheat flour : tapioca : mocaf and moringa leaves on code A1 is 42% : 14% : 40% : 4%, on code A2 is 38% : 12% : 45% : 5% and on code A3 is 34% : 10% : 50% : 6%.

The procedure for making onion stick begins with weighing all the ingredients, and boiling the onion and garlic. Next, mix all the ingredients, mix until evenly distributed. Form the dough using ampia, and deep fry the dough until cooked.

3. Results and Discussion
3.1. Modified Onion Stick Specification
Onion stick were processed with three treatments and obtained different results on all parameters. Table 1 below shows the specifications for onion stick based on color, aroma, taste and texture, which are as follows:

| Characteristics | Treatment |
|-----------------|-----------|
| Color           | A1        | A2        | A3        |
|                 | Brownish yellow and less bright green | Brown with a slightly lit green | The green color is very striking, with a hint of brown |
| Aroma           | The characteristic aroma of onion stick still dominates, with a very slight unpleasant aroma from mocaf flour | The unpleasant aroma of mocaf flour and Moringa leaves is a little strong | The unpleasant aroma of mocaf flour and Moringa leaves is very strong |
| Taste           | Salty and savory typical onion stick | Salty and savory with very little bitterness | Salty and savory with a bit of bitterness |
| Texture         | Fragile but not easily destroyed | Brittle and easily destroyed | Very brittle and easily crushed |

Based on color specifications, A3 stick have the darkest green color compared to A1 and A2. The green color of the product is due to the presence of chlorophyll in moringa leaves. Basically, fresh
moringa leaves are light green, compared to the color of moringa leaf flour which has a dark green color, this is influenced by the process of making moringa leaves into powder form [11].

A1 stick have a distinctive aroma of onion stick, although there is a slight unpleasant smell from mocaf flour, compared to A2 stick which start to smell unpleasant from mocaf flour and moringa leaf flour. While the A3 stick have a more concentrated unpleasant odor than the A2 stick. If more mocaf flour and moringa leaf flour are used, the original aroma of the product will be covered. Moringa leaves have an unpleasant aroma due to the presence of essential oils and lipoxidase enzymes [12].

The taste specifications for A1, A2, and A3 stick are salty and savory, but A2 stick have a slightly bitter taste as well as A3 stick which have a more bitter taste. Even though there is a little bit of bitterness in the A2 and A3 stick, the sticks can still be consumed. The use of more moringa leaves in the product will produce a bitter taste in the result, this is due to the hydrolysis of amino acids in moringa leaves during the heating process [13].

Texture specifications A1 sticks have a brittle texture, but are not easy to break, A2 sticks have a brittle texture but break easily, while A3 sticks have a very fragile texture that causes them to break easily. This is because the ingredients for making the sticks are mixed with mocaf flour which then affects the texture of the sticks. Mocaf flour is free from gluten which makes dough elasticity less elastic. The more using mocaf flour on the sticks makes the sticks more fragile and easy to break [14].

### 3.2. Test Results of Modified Onion Stick Organoleptic Score Assessment

In Table 2, the following shows the number of modified onion stick assessment scores, which are as follows:

| Characteristic | Treatment | Kruskal Wallis Test |
|----------------|-----------|---------------------|
|                | A1        | A2        | A3        | P       |
| Color          | Score %   | Score %   | Score %   |         |
| Color          | 76 84,4   | 59 65,5   | 54 60     | 0,001   |
| Aroma          | 73 81,1   | 55 61,1   | 64 71,1   | 0,017   |
| Taste          | 79 87,7   | 55 61,1   | 57 63,3   | 0,000   |
| Texture        | 81 90     | 63 70     | 67 74,4   | 0,003   |
| Mean           | 77,25 85,8| 58 64,4   | 60,5 67,2 |         |

The measurement results show that stick A1 has the highest scoring score, which is 77.25 or 85.8% and stick A2 has the lowest score with a percentage of 64.4%. Sticks A1 got the highest score because of the composition of the use of mocaf and moringa leaf flour, the least amount of moringa when compared to sticks A2 and A3. This is what makes the A1 stick more similar to the usual onion stick. Previous studies have shown that the most preferred onion sticks are sticks containing 4% moringa leaves [15]. Another study found that the replacement of wheat flour with mocaf flour was more desirable in noodle products, with a ratio of 75% : 25% [14]. Based on the table above, it is known that the parameters of color, aroma, taste and texture in the three treatments have differences with each sig value of 0.001; 0.017; 0.000; 0.003.

The analysis was continued on the Mann Whitney test to see which formulas had differences. The results of the Mann Whitney test can be seen in the following table:

| Characteristic | Mean ± SD | A1 | A2 | A3 |
|----------------|-----------|----|----|----|
| Color          | 2.53±0.73 | 1.96±0.76 | 1.8±0.8 |
| Aroma          | 2.43±0.77 | 1.83±0.79 | 2.13±0.8 |
| Taste          | 2.630.49± | 1.830.87  | 1.9±0.6  |
| Texture        | 2.7±0.45  | 2.1±0.8   | 2.2±0.67 |
In the table above, it is known that the formula A1 has the highest average value of organoleptic specifications, which is 2.57, then A3 is 2 and A2 is 1.93. The discussion of Table 3 is discussed in detail at the following points:

3.3. Organoleptic Test

3.3.1. Color. One of the parameters that is important in assessing the organoleptic test of food products is color. This is because the color in food products is the first thing that attracts consumers’ attention. Table 3 shows that there is a difference between the colors of the sticks A1 and A2, and A1 and A3. However, there is no significant difference between A2 and A3 sticks. A1 sticks are the most preferred by respondents because it only contain 4% moringa which causes the sticks to resemble ordinary onion sticks with a yellowish color. Furthermore, the A1 sticks has a green color that is less bright which makes it still acceptable. While the green color on the sticks A2 and A3 has started to cover the original color of the onion sticks which makes the colors on these sticks less desirable.

The use of moringa leaf flour on the color specification of mocaf flour cookies as much as 0% there is a significant difference in acceptance when compared to the use of 3%, 6% and 9%. However, the use of 3%, 6% and 9% did not get a significant difference in the acceptance of mocaf cookies. This could occur because the more use of moringa leaf flour, the lower the color acceptance of food products [16]. The percentage of the preference test for the color of the modified onion stick is shown in Figure 1 below:

![Figure 1. Percentage of panelists’ preference test assessment based on color](image)

Figure 1 shows, stick A1 gets the highest score with a percentage of 84.4% and is in the preferred category, compared to sticks A2 and A3 which have a total score of 65.4% and 59.9% percentage and are in the less preferred category. Basically the color of the modified onion sticks is green where in each treatment the green color is different. The use of more moringa leaves will make the product have a dark green color. The thing that must be considered when determining the composition of ingredients is that using too much moringa leaf flour, will reduce the acceptance of food products because it will have a thick color and make the color of the product dark, so it is no longer attractive. The chlorophyll contained in moringa leaf flour makes onion sticks green. The amount of chlorophyll contained in 8 g of moringa leaf flour is 162 mg [13]. The addition of a small amount of moringa leaf flour can give a fresh effect on the color of the product, but using a lot of moringa leaves causes the color getting darker and darker.

3.3.2. Aroma. The results of the Kruskal-Wallis test in Table 2 show that there are differences in acceptance of the aroma sticks A1, A2, and A3 with the value sig = 0.017. Then further analysis was carried out using the Mann-Whitney test. The results in Table 3 showed, that there was a significant...
difference between sticks A1 and A2, but between sticks A1 and A3, and A2 and A3 there was no significant difference. The test results on sticks A1 and A3 did not show any significant difference, when viewed from the material composition of the two treatments, they were the opposite. The A1 stick has the least material composition, inversely proportional to the A3 stick, which is the highest material composition. This can happen because the amount of mocaf flour and moringa leaf flour on sticks A1 (40% : 4%), still has good reception from respondents, because the aroma is still the same as the aroma of ordinary onion sticks. However, on stick A3 (50% : 6%) there is a distinctive aroma that can steal the attention of respondents.

The percentage of the preference test for the aroma of the modified onion sticks is shown in Figure 2 below:

![Figure 2. Percentage of panelists' preference test assessment based on aroma](image)

The results of the organoleptic test on aroma in Figure 2 show, stick A1 gets the highest score of 73 or 81.1%, then followed by stick A3 with a total score of 64 or 71.1%, and stick A2 with a total score of 55 or 61%. Mocaf and moringa leaf flour have an influence on the aroma of the resulting product. Sticks A1 has the highest score because the composition of mocaf flour and moringa leaf flour is 40% and 4%, while sticks A2 and A3 use mocaf flour and moringa leaf flour with a ratio of 45% : 5% and 50% : 6%. The use of more and more material compositions makes the aroma of the food product produced has an unpleasant and strong aroma.

Moringa leaves contain essential oils and lipoxidase enzymes which then affect the aroma of the food. Green vegetables contain lipoxidase enzymes which then give rise to unpleasant odors if not processed properly. processing in the form of fresh leaves can be slightly reduced by doing the boiling process using salt or soaking it with cold water [12]. Mocaf flour also has a distinctive aroma because it comes from cassava fermentation, although it has gone through the fermentation process, it still leaves a distinctive aroma [14]. The aroma of the onion sticks can be enhanced by adding other ingredients such as margarine to reduce the unpleasant smell of mocaf flour and moringa leaf flour.

3.3.3. Taste. Table 2 shows that there is a significant difference in the acceptance of the taste of the sticks A1, A2, and A3 with a p value of 0.000. Then the analysis was continued with the Mann-Whitney test, it was found that, there was a significant difference between sticks A1 and A2 and A1 and A3, each sig = 0.000. However, between sticks A2 and A3 there is no significant difference, the value of sig = 0.595 is obtained. The addition of mocaf flour and moringa leaf flour will affect the taste of the onion sticks. This is because the other ingredients such as eggs, spices, and butter on sticks A1, A2, and A3 are the same, which makes the ingredients unable to balance the distinctive taste of mocaf flour and moringa leaves. If more mocaf flour and moringa leaf flour are used, it will reduce the taste of the original food product [17]. The distribution of panelists’ preferences for the taste of modified onion sticks can be seen in the following figure:
Based on the picture above, it was found that the A1 stick got the highest scoring score, which was 79 or 87.7%, then continued to the A3 stick, 57 or 63.3%, and the A2 stick as much as 55 or 61%. The ratio of using mocaf and moringa leaf flour is 40% : 4% on sticks A1, being the comparison of the composition of the most desirable ingredients. This is because the use of mocaf flour and moringa leaf flour which tends to be a little has no effect on the taste of the onion sticks, which makes it still enjoyed by the respondents. Adding a lot of moringa leaves in food products, can make the product taste bitter. This is due to the hydrolysis of amino acids in moringa leaves due to the heating process when loading a food [13].

A previous study showed that adding of moringa leaf flour by 3% on mocaf cookies, got the highest acceptance with a mean value of 3.67, compared to cookies with 9% added moringa leaf flour which got the smallest acceptance with a mean value of 2.64. Using a lot of moringa leaves, it will reduce the level of acceptance of respondents [16].

3.3.4. Texture. Texture specifications, become one of the determinants of assessment by using the tactile senses. If the texture of the food is good, it will add to the appearance of the food, so it will affect its reception [15]. Table 2 shows that there are significant differences between formulas, obtained the value of sig = 0.003. Then further analysis with Mann-Whitney test obtained that, between sticks A1 with A2, and A1 with A3 there is a significant difference, but between sticks A2 and A3 there is no significant difference, the obtained value of sig = 0.545. The distribution of the panelists' preference level on the texture of the modified onion sticks is shown in the following figure:

![Figure 3. The percentage of panelists' preference test assessment based on taste](image)

![Figure 4. The percentage of panelists' preference test assessment based on texture](image)
by respondents is the A1 stick, which has a texture that is not easily crushed and broken, so it has a more attractive appearance.

Previous studies have shown that mocaf sticks enriched with green vegetables such as spinach will have a crumbly texture if you add more mocaf flour mixture. This is influenced by the amount of amylose and amylopectin derived from carbohydrates which then affects the texture of the food, the greater the amylopectin content in the food, the more crunchy the food will be, the amount of amylose and amylopectin in mocaf flour is 19% and 81%. [18].

4. Conclusion
The results of organoleptic tests on color, aroma, taste and texture specifications showed a significant difference in onion sticks modified with mocaf flour and moringa leaf flour. A1 sticks with a composition of 40% mocaf flour and 4% moringa leaf flour get the most favorable acceptance score of 85.8%, then A3 sticks with a composition of 50% mocaf flour and 6% moringa leaf flour with a total favorite score of 64.4%, and sticks A2 with a composition of 45% mocaf flour and 5% moringa leaf flour got an acceptance score of 67.2%. Formula A1 has the highest acceptability score, so it should be continued for nutrient analysis and testing its effect on Hb levels of anemic adolescent girls.

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