

Effect of Substitution of Spinach Flour (*Amaranthus Sp*) to Iron (Fe) Content and Acceptability of Donuts

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ABSTRACT

Spinach is a great source of iron (Fe), which is quite high. Spinach can be made into spinach flour that can be used making donuts. Donuts in general have only macro nutrients and very few other nutrients, so substitution of spinach flour is needed to increase the nutritional content of donuts, especially on iron content. The purpose of this research is to know effect of substitution of spinach flour to iron content and acceptability of donuts. The method of this research used complete random design with four substitution treatment of spinach flour (0%, 10%, 20%, and 30%). Data analysis of iron content using one way ANOVA test with 95% significance level continued Duncan test, while acceptability using Kruskal Wallis test followed by Duncan test. The results showed that the highest iron content found in donuts with 30% spinach flour substitution with the result of 135.72 mg/kg, while the lowest on donuts with 0% spinach flour substitution with the result 43.78 mg/kg. Based on the overall percentage of acceptability the highest found in donuts with 0% spinach flour substitution, while the overall percentage of acceptability the lowest found in donuts with 30% spinach flour substitution. Based the analysis test known that there is effect of substitution of spinach flour to iron content of donuts. There is also effect of substitution of spinach flour to acceptability color, aroma, flavor, texture, and overall donuts.

Keywords: acceptability; donuts; iron content; spinach flour.

1. INTRODUCTION

Type of vegetable consumption is often long beans, kale, tomatoes, eggplant, and spinach. Spinach production in Indonesia increased by 3.13% from 2015 to 2016, namely; 150,085 tons to 160,247 tons. Estimates of the total national consumption of spinach per year increased from 2015 to 2016 amounting to 1027.42 kg to 1158.40 kg (BPS, 2017).

Spinach is a green leafy vegetable that is low in calories and is considered a source of vitamins (ascorbic acid, riboflavin, niacin and folic acid), minerals (iron and calcium), and dietary fiber (Ozkan et al., 2014). Spinach iron content is 2.32 mg/100 g (USDA, 2017).

Spinach can be made into spinach flour which is suitable for use in cake products (Shyam and Raghuvanshi, 2015). Spinach in the form of flour has the advantage that it is more durable, practical, can be enriched with nutrients, and intermediate products that are easily applied to other food forms (Damardjati and Suismono, 2000).

One of food product that can be made using spinach flour is donut. Donut is food that is made from wheat flour which is added with bread yeast and then fried. In the donut mixture added sugar, margarine, salt and eggs (BPOM, 2003). Donuts have long been known as food that is quite filling. This time, donut is one of the favorite cakes and trends for all people (Sufi, 2009).

Donuts general only macro nutrients and have very little other nutrients such as iron (Travanita, 2013). Therefore, efforts to improve the nutritional quality of donuts are very necessary, especially for iron content. In this research substitution of spinach flour will be carried out on donuts. Through substitution of spinach flour is expected to increase the nutritional content of donuts, especially against the iron content. In addition, this research will also evaluate the acceptability of donuts by substituting spinach flour.

2. METHODS

2.1. Materials

The materials in making donuts with substitution of spinach flour are flour, spinach flour, sugar, margarine, instant yeast, salt, eggs, baking powder, water, and cooking oil.

2.2. Tools

The tools used in the research are scales, basins, grinders, and flour sieves 60 mesh, scales, bowls, spoons, rolling pins, sticks, chopsticks, pans, spectrophotometers, crucible porcelain, muffle furnaces, mortal porcelain, filter paper, Erlenmeyer, pumpkin taker, funnel, analytic balance, measuring cup and pipette.

2.3. Making spinach Flour

The procedure for making spinach flour follows the procedure of Ningsih (2012). First, We washing the spinach with the water flow. Spinach is then cut into the trunk. Then, spinach leaves are dried. Spinach leaves dry already done smoothing or grinding. After that, sifted with a size of 60 meshes.

2.4. Making Donut

The procedure for making donuts is wheat flour mixed with spinach flour along with other additives (sugar, milk powder, instant yeast, baking powder, margarine, salt, and eggs), where substitution of spinach flour in the mixture is 0%, 10%, 20% and 30% of wheat flour. Next, all the dough is mixed, ± 100 ml of water is added and stirred until smooth. Then proceed with the first fermentation stage for 30 minutes. After that, the

dough is formed according to the donut shape and the second fermentation for 15 minutes. The final stage, the mixture is fried in hot conditions.

2.5. Analysis of Iron (Fe) Content

Iron analysis procedures using Day and Underwood (1994) procedures were carried out using Spectrophotometry method. The stages of iron analysis are: weighed 5 grams of refined samples in porcelain crucible. Then, sample it in a muffle furnace until it forms into ash. Ash is dissolved using 50 ml of HNO₃ 1: 3 while ground in porcelain mortar. Next, filtered using filter paper and collected filtrate into 100 ml Erlenmeyer. Then, take 1 ml of clear filtrate and add 2 ml of NH₄SCN 1.5 M, if the sample contains iron (Fe) then the color of the solution will turn red. After that, add distilled water to a volume of 10 ml then read the absorbance using a spectrophotometer with a wavelength of 510 nm. Finally, note the data obtained, then calculated using the standard Iron curve. second

2.6. Acceptability Analysis

According to Ariyanti (2010), acceptability was obtained through organoleptic testing conducted by 30 untrained panelists. The steps of acceptability testing are, first, the distribution of forms and samples to the panelists, second a general explanation of the method of assessment. Third, the panelists conducted an assessment.

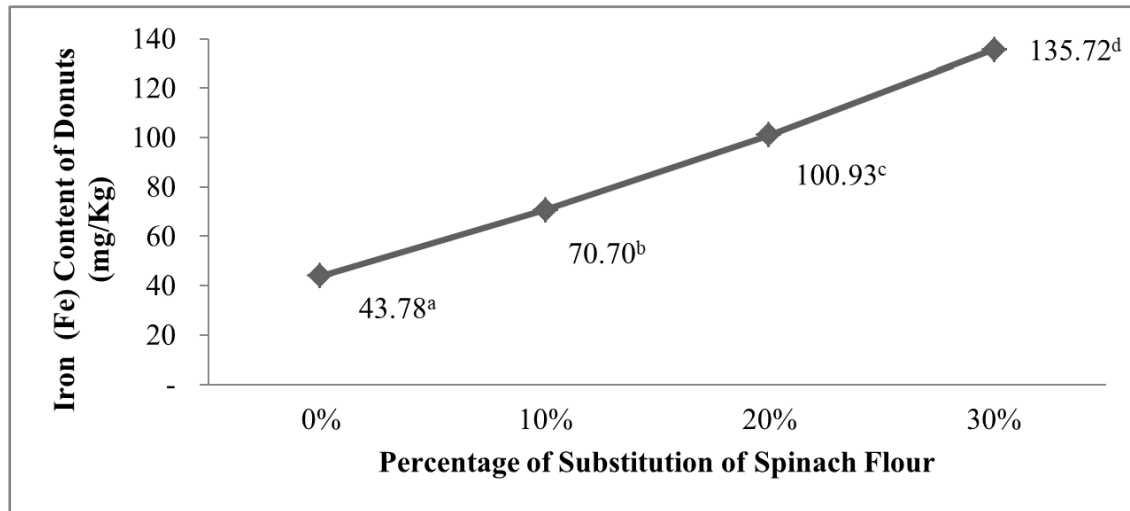
2.7. Research Design

The research design used in this study was a complete random design with four substitution treatments of spinach flour, namely 0%, 10%, 20%, and 30%. Data on iron content were analyzed by one way ANOVA test with 95% significance level. If there is significance then continue using post hoc test with Duncan analysis at a significance level of $\alpha = 0.05$. Data on Acceptability were analyzed through the Kruskal Wallis test then if there was influence, then it was continued with a significantly difference test using Duncan's analysis with 95% significance level.

3. THE RESEARCH RESULTS AND DISCUSSION

3.1. Iron (Fe) Content

Based on the results of the one way ANOVA statically test with 95% significance level using SPSS program version 20 on iron content showed that the p value = 0.001 ($p < 0.05$), this means that there is an effect of substitution of spinach flour to iron content of donut. Iron content of donut with various percentages of substitution of spinach flour can be found on the Graph 1.



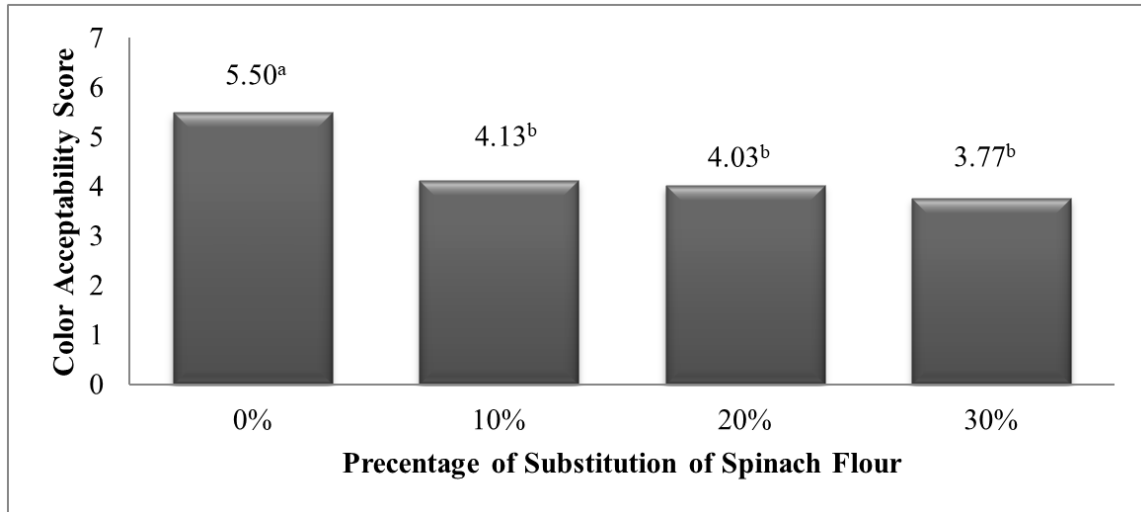
Graph 1. Iron (Fe) Content of Donuts Substituted with Spinach Flour

Based on Graph 1, the difference in the rate of substitution of spinach flour gives differences in iron content. Iron content in donuts which are substituted with spinach flour has increased iron content of donuts from substitution of spinach flour 0% to 30%. Graph 1, It shows that the iron content can be seen that the more substitution of spinach flour, the higher the iron content in the donut, which shows an increase of 43.78 mg/kg to 135.72 mg/kg. The highest average iron content was donut with 30% spinach flour substitution, while the lowest was donut with 0% spinach flour substitution. Donut iron content was influenced by the percentage of spinach flour substitution. Substitutes of spinach flour to increase iron content in donuts. The test result of iron content on spinach flour alone were 518.13 mg/kg so that when spinach flour was substituted on donuts with a treatment of substitution of 0% to 30% spinach flour resulted in an increase in iron content. The higher the substitution concentration of spinach flour, the iron content produced also increases. This is consistent with the opinion of Ningsih (2005) which states that there is an increase in iron content in steamed sponge cake with the increasing substitution of spinach flour used. The results of Galla et al. (2017) also showed that the more addition of spinach flour to the biscuits, the higher the iron content of biscuit. According to Shyam and Raghuvanshi (2015) on eggs less cakes with the addition of spinach flour more and more iron content will increase.

3.2. Organoleptics Test Result

a. Color

Based on the Kruskal Wallis statistic test using SPSS program version 20 shows that the p value = 0.001 ($p < 0.05$), this means that there is an effect of substitution of spinach flour on the color acceptability of donuts. Color acceptability test of donut substituted with flour spinach can be seen in Graph 2.



Graph 2. Color Acceptability of Donuts Substitute with Spinach Flour

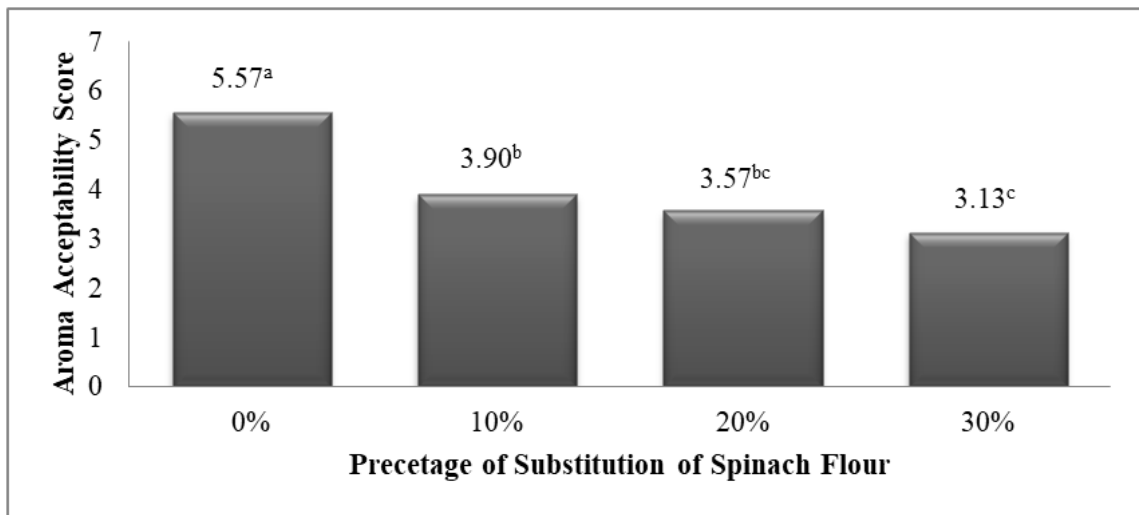
Based on Graph 2, color acceptability of donut with spinach flour substitution treatment 10%, 20%, and 30% showed that the level of acceptability was not significantly different. The differences appear at the lowest substitution of 0%. The highest color acceptability score is donuts with 0% spinach flour substitution with an average value of 5.50 or in the like category, while the lowest color acceptability score is donuts with 30% spinach flour substitution where the average value is 3.77 or included in the rather like category.

The more amount of substitution of spinach flour in donut, the darker the donut produced. Donuts with substitution of spinach flour 10%, 20%, and 30% have a green color, this is because spinach gives a green color to the donuts. This is consistent with the opinion of Aprilianingtyas (2009) who stated that the addition of spinach vegetables and carrots to empek-empek¹ products caused the color to be less attractive because it was too dominated by the green color of spinach. The green color of spinach is caused by spinach containing chlorophyll. Chlorophyll is a green pigment found in chloroplasts (Sumaenda, 2011).

b. Aroma

Kruskal Wallis statistic test using SPSS program version 20 shows that p value = 0.001 ($p < 0.05$), this means that there is an effect of substitution of spinach flour on the aroma acceptability of donut. The results of the aroma acceptability test of donuts substituted with spinach flour can be seen in Graph 3.

¹ Empek-empek is one of the traditional foods of the people of South Sumatra which is made from a mixture of fish, tapioca flour, water and salt that is evenly mixed and then formed, boiled and drained (Aprilianingtyas, 2009).



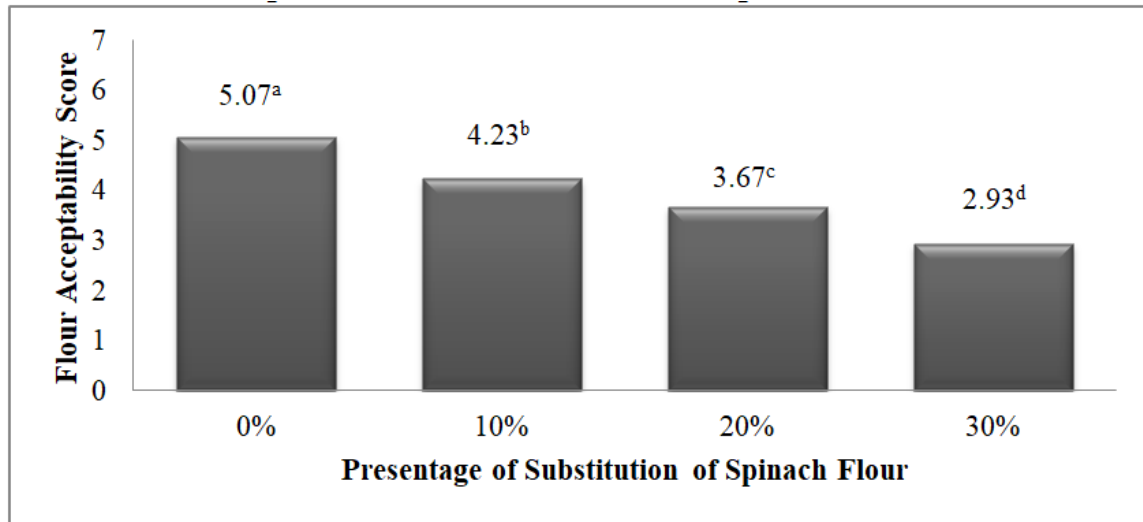
Graph 3. Aroma Acceptability of Donuts Substitute with Spinach Flour

Based on the Graph 3, the difference in the level of substitution of spinach flour gives a difference in preference for the aroma of donuts. The highest score of aroma acceptability is donuts with 0% spinach flour substitution with a value of 5.57 or including a very like category. While the lowest aroma acceptability score is a donut with 30% spinach flour substitution where the average value is 3.13 or not like the category.

Panelists assessment of the aroma of donuts showed that the lower the substitution of spinach flour, the higher the level of preference. This is in accordance with the opinion of Galla et al. (2017) which states that the more addition of spinach flour to the biscuits, the lower the aroma acceptability of biscuit. Fitriyani (2013) research results also show that panelists preference for the aroma of white bread tends to decrease if more and more spinach juice is added. Fitriyani (2013) explained that spinach has a distinctive smell when mixed with food processing. The panoramic smell is not preferred by the panelist because it creates a bad smell. According to Andarwulan et al. (2011) the smell of green vegetables is caused by the lipoksidase enzyme when the cooking is not perfect will cause unpleasant odor .

c. Flavor

Kruskal Wallis statistic test using SPSS program version 20 shows p value = 0.001 ($p < 0.05$), this means that there is an effect substitution of spinach flour to flavor acceptability of donut. Donut flavor acceptability substituted with spinach flour can be seen in Graph 4.



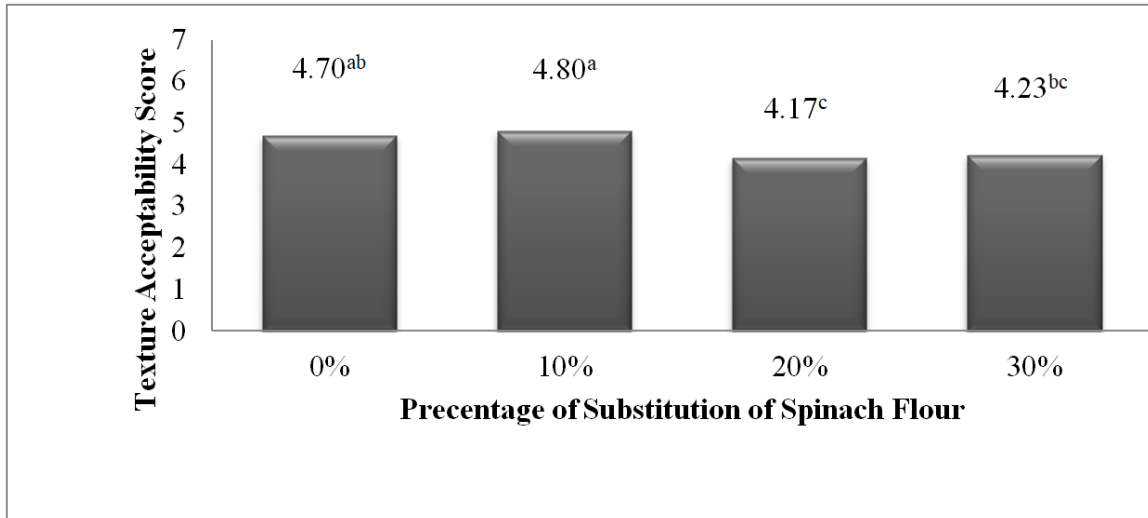
Graph 4. Flavor Acceptability of Donuts Substitute with Spinach Flour

Based on Graph 4, the difference in the level of substitution of spinach flour gives a different preference for the flavor of donuts. The highest flavor acceptability score is donut with 0% spinach flour substitution with an average value of 5.07 or including in the likes category. While the lowest flavor acceptability score is donut with 30% spinach flour substitution where the average value is 2.93 includes dislike category.

Based on Graph 4, it is known that the panelist's assessment of donut flavor decreases when more and more substituted spinach flour. This is in accordance with the opinion of Galla et al. (2017) which shows that the more addition of spinach flour to the biscuits, the lower the flavor acceptability of the biscuit. This is also reinforced by the opinion of Mahayani et al. (2014) which states that with the addition of spinach to wet noodle, the panelists preference for wet noodle flavors tends to decrease. Another study conducted by Indraswari (2017) on the catfish dragon foot nugget is decreasing panelists preference if the greater proportion of spinach is added. This is because the flavor of spinach tends to be dry the greater the addition of spinach, the stronger the flavor is produced.

d. Texture

Kruskal Wallis statistic test using SPSS program version 20 shows that p value = 0.021 ($p < 0.05$), this means that it means that there is an effect of substitution of spinach flour to texture acceptability of donut. The results of the texture acceptability test for donuts substituted with spinach flour can be seen in Graph 5.

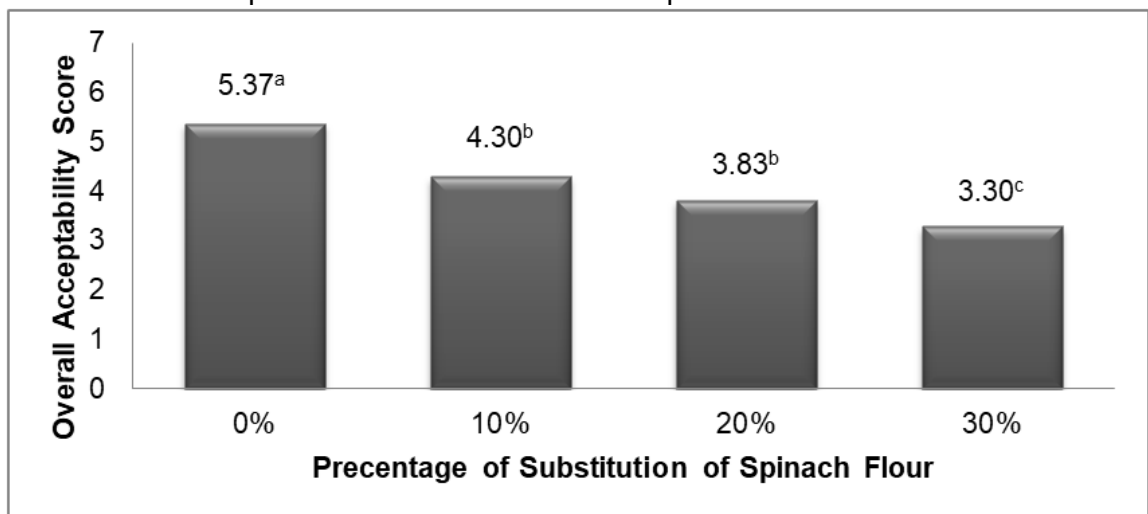


Graph 5. Texture Acceptability of Donuts Substitute with Spinach Flour

Based on Graph 5, the treatment of substitution of spinach flour in each concentration variation gave a different preference scores for texture attributes. The highest texture acceptability score is donuts with 10% spinach flour substitution with an average value of 4.80 or included in the likes category, while the lowest texture acceptability score is donuts with 20% spinach flour substitution where the average value is 4.17 or included in the rather like category. The texture of the donut is influenced by the materials of making and substituting spinach flour. On the research of previously stated that the texture of mocha biscuits flour decreases if the addition of spinach flour increasing, this was due to a decrease in the density of the biscuit texture (Simanjuntak, 2016).

e. Overall

Kruskal Wallis statistic test using SPSS program version 20 shows that p value = 0.001 ($p < 0.05$), this means that there is an effect of substitution of spinach flour to overall acceptability of donut. The result of the overall acceptability test of donuts substituted with spinach flour can be seen in Graph 6.



Graph 6. Overall Acceptability of Donuts Substitute with Spinach Flour

Based on Graph 6, the overall acceptability of donuts with substitution of spinach flour treatment is 10% and 20% indicates the level of acceptability is not significantly different. The difference appears at the lowest and highest substitution of 0% and 30%. The highest overall acceptability score was donuts with 0% spinach flour substitution with an average value of 5.37 or included in the likes category, while the lowest overall acceptability score was donuts with 30% spinach flour substitution with an average value of 3.30 or included in the dislike category.

The Panelists overall acceptability is influenced by the color, aroma, flavor, and texture of donuts. The color of the donut gets darker if the greater the substitution of spinach. The aroma of donuts with substitution of spinach flour has a distinctive smell. The flavor of donuts is getting worse if more and more substitution of spinach flour, and the texture of donuts is rather hard. The texture of the donut is influenced by the materials of making and substitute's spinach flour.

4. CONCLUSION AND SUGGESTION

4.1. Conclusion

The conclusion of this research was that the highest iron (Fe) content found in donuts with 30% spinach flour substitution with the result of 135.72 mg/kg and the lowest iron (Fe) content found in donuts with 0% spinach flour substitution with the result of 43.78 mg/kg. Based on the overall percentage of acceptability the highest found in donuts with 0% spinach flour substitution with a value of 5.53 (like) and the lowest acceptability is in donuts with 30% spinach flour substitution with a value of 3.30 (dislike). Based the statistical analysis test, it was found that there was an effect of substitution of spinach flour to iron content of donuts. The results of the statistical analysis also showed there was an effect of substitution of spinach flour to acceptability color, aroma, flavor, texture, and overall donuts.

4.2. Suggestion

More research needs to be done about the right treatment to reduce the bad smell of spinach donuts. In addition, further research is needed on the test of the power save of spinach donuts to know the level of durability during storage. Also need to do more research on fiber content in spinach donuts to know the value of its nutrition value.

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