

Testing the Acceptance of Soybean Tempeh Substituted with Chicken Liver Flour to Prevent Iron Deficiency Anemia

Mohammad Zainul Ma'arif¹, Yuniars Renowening², Himmatunnisak Mahmudah³

^{1,2,3}Nutrition Study Program, Faculty of Health Sciences, Sugeng Hartono Institute of Science and Health Technology, Sukoharjo, Indonesia

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ABSTRACT

Keywords:

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Iron deficiency anemia is a major health problem caused by iron deficiency. Many women of childbearing age and adolescents in Indonesia experience this condition. This condition needs to be handled appropriately because it can have a negative impact on the quality of life of teenagers and their offspring. Therefore it is necessary to develop food products with high iron content to increase the dietary iron intake. Soybean tempeh is a local food that can be developed as a food source for iron by substituting chicken liver flours. Chicken liver is a food source of high-quality animal protein and heme iron. This study aimed of this research was to analyze the acceptability of soybean tempeh products substituted with chicken liver flour. This study used a completely randomized experimental design. There were 4 formulas and 1 control group without substitution. Percentage of chicken liver flour substitution in groups F1 (5% chicken liver flour), F2 (10% chicken liver flour), F3 (15% chicken liver flour), and F4 (20% chicken liver flour). Acceptability tests were performed on the color, aroma, taste, and texture parameters using 25 semi-trained panelists. The acceptability test results showed that F1 underwent the closest acceptability test to the control group, especially in terms of color, taste, and texture ($p > 0,05$). The F2, F3, and F4 groups were less preferred, especially in terms of aroma and taste parameters. As a product intended to meet dietary iron requirements, efforts need to be made to improve the acceptability of aroma parameters.

Email :

zainmaarif01@gmail.com

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1. INTRODUCTION

Anemia is a nutritional problem that often occurs in pregnant women, women of childbearing age and teenagers [1]. The rate of anemia worldwide is 1,9 billion people [2]. This condition is most often caused by iron deficiency and is known as iron deficiency anemia. Iron deficiency anemia is generally caused by gastrointestinal bleeding, prolonged menstruation, a lack of iron intake, and impaired iron absorption in the small intestine. This condition of iron deficiency anemia will have an impact on the sufferer's quality of life and will also have an impact on their offspring if they are suffering from a pregnant mother. Some of the risks arising from iron deficiency anemia include fatigue, impaired cognitive function, and decreased quality of life [4,5,6]. Even if the mother experiences iron deficiency anemia during pregnancy, it can have an impact on premature babies and low birth weight [7]. Iron deficiency anemia occurs when the iron stores in the body are low. This condition interferes with the formation of hemoglobin during erythropoiesis, resulting in low blood hemoglobin levels [8]. The cut off point for someone to be diagnosed with iron deficiency anemia is when the hemoglobin level is <13 g/dL in men and <12 g/dL in women [9].

In Indonesia, teenagers and women of childbearing age are highly vulnerable to iron deficiency anemia, with a prevalence of 35,3% [10]. Efforts to reduce the prevalence of deficiency anemia have been made by providing iron in the form of an Iron Tablet Supplementation program. However, in its implementation, there are still obstacles which include factors such as ignorance, lack of motivation,

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and the emergence of various uncomfortable side effects [11,12,13]. Therefore, other efforts are needed to ensure that anemic sufferers continue to receive an adequate supply of iron, especially from foods high in iron. Moreover, low oral iron intake and low bioavailability of iron from food are the main causes of iron deficiency anemia [14].

Indonesia has a diverse range of natural biological resources. One of the diversities of Indonesia is the type of local food, namely soybean tempeh. Tempeh has become a food that is often consumed by Indonesians as side dishes or snacks. According to the Central Agency of Statistics Agency data, tempeh consumption in Indonesia has shown an increasing trend over the last 10 years, from 133 g/week in 2010, to 140 g/week in 2022 [15]. Therefore, soybean tempeh has the potential to be developed as a local food to solve the problem of iron deficiency anemia. Substitution is one way that can be done in efforts to develop food products. Food ingredients that can be used as substitutes to increase iron content include chicken liver. Chicken liver is classified as having a fairly high iron content, because the liver is a storage site for iron [16]. According to the Tabel Komposisi Pangan Indonesia (TKPI), the iron content in 100 g of chicken liver is 15,8 mg [17]. The iron contained in chicken liver is a type of heme iron that can be absorbed more easily than the non-heme iron contained in plant foods [18]. In addition, iron from chicken liver is more easily absorbed because it contains fewer mineral-binding agents. Chicken liver is also a food source for animal protein and can be used to improve the protein quality of tempeh. Based on this background, it is necessary to test the organoleptic of soybean tempeh products with chicken liver flour as a substitute to obtain the best formulation that can be accepted by consumers in an effort to overcome iron deficiency anemia.

2. METHOD

This study was an experiment with a completely randomized experimental design. In this study, soybeans were substituted with chicken liver flour at four levels (5%, 10%, 15%, and 20%). Soybean tempeh substituted for chicken liver flour and organoleptic tests were performed at the Food Technology Laboratory, Nutrition Study Program, Faculty of Health Sciences, Sugeng Hartono Institute of Science and Health Technology from August to September 2023.

The chicken liver flour made from fresh chicken liver and tools, including a cutting knife, cabinet dryer, and 60 mesh sieve. Chicken livers that had been washed were sliced thin using a knife. Next, the chicken livers were dried in a cabinet dryer at a constant temperature of 60°C for 12 hours. After drying, the chicken livers were ground using a disk mill and sieved using sieving until 60 mesh flour was obtained. After obtaining the chicken liver flour, then proceed with making soybean tempeh were prepared by referring to the standard steps for the soybean tempeh production process according to the National Standardization Agency of Indonesia (2012) [19].

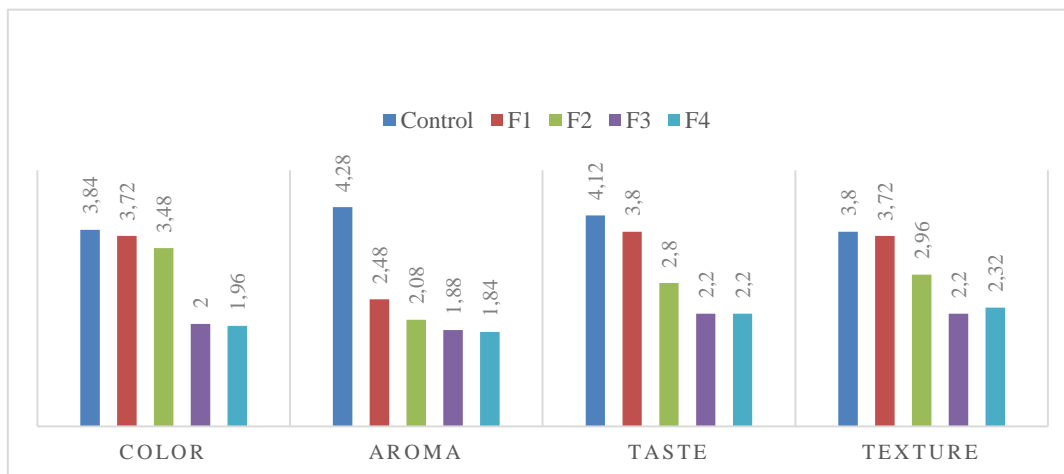
Next, an organoleptic test to measure the level of acceptability was conducted on 25 semi-trained panelists. Organoleptic tests were performed to measure the level of acceptability in terms of color, aroma, taste, texture, and overall parameters. The acceptability level scale used is 5 levels including 1 = really do not like it, 2 = do not like it, 3 = neutral, 4 = like it, and 5 = really like it. Next, the data were tabulated and analyzed statistically using the Mann-Whitney test with a significance level of 95%.

3. RESULTS AND DISCUSSION

Based on this research, the author describe the panelist-level acceptance of tempeh substituted with chicken liver flour, as shown in Table 1 and Figure 1. The most preferred color parameters were the control, F1, and F2 group, where all three obtained an average preference score of >3. Meanwhile, the F3 and F4 groups were less accepted by panelists. Among the aroma parameters, only the control group was preferred by panelists. Regarding taste and texture parameters, panelists liked only the control and F1 groups. For more details, see Table 1 and Figure 1.

Table 1. Mean Rank of the Panelist Level Acceptance of Tempeh Substituted for Chicken Liver Flour

Group	Color	Aroma	Taste	Texture
Control	3,84	4,28	4,12	3,80
F1	3,72	2,48	3,80	3,72
F2	3,48	2,08	2,80	2,96
F3	2,00	1,88	2,20	2,20
F4	1,96	1,84	2,20	2,32
Kruskall wallis test	0,001*	0,001*	0,001*	0,001*

 Note: significantly different ($p < 0.05$), followed by the Mann Whitney test

Figure 1. Comparison of the Panelist Level Acceptance of Tempeh Substituted for Chicken Liver Flour

As shown in Table 1 and Figure 1, of the 25 panelists, the most liked the control group tempeh for all parameters, followed by tempeh with 5% chicken liver flour substitution (F1 group). The F1 group received a good assessment of color, taste, and test parameters. Group F2 received a good acceptability rating for the color alone. Meanwhile, groups F3 and F4 tended to be less liked by panelists. For more details, this was proven by the results of the Mann-Whitney test analysis.

Table 2. The Different Test of the Panelist Level Acceptance of Tempeh Substituted for Chicken Liver Flour

Group comparison	<i>Mann Whitney Test</i>			
	Color	Aroma	Taste	Texture
Control F1	0,669	0,001*	0,341	0,784
Control F2	0,129	0,001*	0,001*	0,004*
Control F3	0,001*	0,001*	0,001*	0,001*
Control F4	0,001*	0,001*	0,001*	0,001*

 Note: significantly different ($p < 0.05$)

Color

Based on organoleptic tests of color parameters, the F1 and F2 groups received the same level of color preference as the control group ($p > 0.05$). The F3 and F4 groups were significantly different from the control group ($p < 0.05$). The level of preference for the F1 and F2 groups was due to the percentage of substitution applied to tempeh, which was still relatively small, that is only 5% and 10%, respectively. Applying a higher percentage to F3 and F4 resulted in a lower level of acceptance. This was caused by the substitution of a high percentage of chicken liver flour, causing the color of tempeh to tend to be reddish brown. This is in line with other research showing chicken liver causes a darker color change, so it is less liked by panelists [20]. Chicken liver color is strongly influenced by

the heme iron content in the form of myoglobin [21]. Oxidation and breakdown of heme molecules during the heating process caused the change in chicken liver color to be less favorable to panelists.

Aroma

Based on organoleptic tests on color aroma parameters, all formula groups F1, F2, F3, and F4 received a lower level of aroma preference than the control group ($p < 0.05$). Chicken liver has an undesirable fishy aroma [22]. This causes tempeh, which is substituted for chicken liver flour, to also have a fishy aroma that is not liked by panelists. This result is supported by other studies that chicken liver causes a fishy odor in food fortified with chicken liver flour [23].

Taste

Based on organoleptic tests of taste parameters, F1 received the same level of taste preference as the control group ($p > 0.05$). Meanwhile, F2, F3 and F4 were significantly different from the control group ($p < 0.05$). The level of preference for F1 was the same as that of the control group, because the percentage of substitution applied to tempeh was still relatively small. Applying a higher percentage of substitution to F2, F3, and F4 resulted in a lower level of acceptance. This is because the substitution of chicken liver flour with a high percentage causes a slightly bitter taste, which the panelists do not like. The bitter taste in chicken liver is due to presence of a compound called mercaptan. This result is related to other research showing that chicken liver flour causes a low level of panelist preference [23].

Texture

Based on organoleptic tests of texture parameters, the F1 received the same level of texture preference as the control group ($p > 0.05$). Meanwhile, F2, F3 and F4 were significantly different from the control group ($p < 0.05$). The level of preference for F1 was the same as that of the control group, because the percentage of substitution applied to tempeh was still relatively small. Applying a higher percentage of substitution to F2, F3, and F4 resulted in a lower level of acceptance. This is due to the substitution of a high percentage of chicken liver flour which causes the texture to tend to be compact and rather hard, which is not preferred by the panelists.

4. CONCLUSION

Based on the results of research on the Testing of Acceptance of Soybean Tempeh Substituted with Chicken Liver Flour to Prevent Iron Deficiency Anemia, it can be concluded that the level of panelist acceptance of tempeh with the best substitution of chicken liver flour is F1 with a substitution percentage of 5%, particularly in terms of color, taste, and texture parameters. The aroma parameters must be improved to eliminate the fishy aroma. We would like to thank the Directorate General of Vocational Education, Ministry of Education, Culture, Research, and Technology of the Republic of Indonesia for providing funding for this research in the 2023 funding year.

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