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COLEUS AMBOINICUS (BANGUN-BANGUN LEAVES) AND STOLEPHORUS COMMERSONII (ANCHOVIES) BISCUIT IN INCREASING IRON INTAKE IN ADOLESCENT GIRLS

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ABSTRACT

Adolescent girls are more susceptible to anemia so good nutritional intake is needed to meet these iron needs. to meet iron needs in adolescents. Bangun-bangun leaves biscuits and anchovies that are rich in iron can be a solution to meet the iron needs of adolescent girls. This study aimed to determine the selected formulation, the effect of adding bangun-bangun leaves and anchovies to biscuits and the iron content of biscuits. This research was an experimental research, with the RAL (Complete Randomized Design) research method. Laboratory tests on the products of bangun-bangun leaves and anchovies were conducted to determine the iron content contained in the products. Data collection was conducted on 22 fairly trained panelists, to test the organoleptic of the products of bangun-bangun leaves and anchovies. Based on the results of the hedonic test, F3 biscuits were the most preferred formula compared to other formulations. Based on statistical tests, data was obtained that there was a significant difference ($p < 0.05$) between the color, aroma, taste and texture of all formulas. The results of laboratory tests showed that the more bangun-bangun leaves and anchovies were added, the higher the iron content in the biscuits. By consuming F3 biscuits as additional food, it could meet the iron needs of adolescent girls, which was 15% of the total daily requirement. F3 biscuits can be an alternative substitute for snacks or supplementary food for adolescent girls to meet their iron intake needs so that they can prevent anemia.

Keywords: anchovies, bangun-bangun leaves, biscuit

Introduction

Iron is one of the nutrients needed by the body, especially in adolescence. Iron is obtained from food and through the process of erythrocyte destruction (recycling) in the reticulo endothelial by macrophages.[1] Iron has an important function and role in monoamine synthesis, energy metabolism, myelination process, neurotransmitter system, and dopamine metabolism.[2] Iron deficiency can cause anemia where the body has Hb levels in the blood below normal[3] Anemia affected or inhibited physical performance and cognitive function and reduce immune function,[4] Long-term iron deficiency can worsen a person's condition, resulting in resistance to infectious diseases and affecting nutritional status.[2] Adolescent girls were more susceptible to anemia due to menstruation, which caused an increase in the need for iron, so good nutritional intake was needed to meet this iron requirement.[5] The prevalence of anemia among adolescents 15-24 years old in Indonesia is quite high, which is 32% with an estimate of 3-4 adolescents out of a total of 10 adolescents suffering from anemia. The proportion of anemia among females (27.2%) is higher than males (20.3%).[6] One of the Indonesian government programs to prevent anemia among adolescent girls is the provision of Blood Supplement Tablets, which is a supplementation in addition to supplementary food.[7]

The problem of iron deficiency in adolescents can be overcome by providing supplementary food. Supplementary food that was given could be in the form of iron-rich biscuits that were needed to meet the iron needs of adolescents. Biscuits were one of the snacks that are consumed by most people. Biscuits were consumed at any time and are easy to carry anywhere. In addition to being easy to carry and could be consumed at any time, biscuits had a relatively long shelf life, which was approximately one year.[8] Biscuits was one of the snack choices for most people and was used as a snack. The making of biscuits in its increasingly diverse development is to substitute wheat flour with other flours that had high nutritional value. Biscuits that were rich in iron were needed to meet the iron needs of teenagers.[9]

Biscuits made from bangun-bangun leaves, anchovies and raisins could be a solution to the problem of iron deficiency in teenagers.[9] In its use, bangun-bangun leaves were mostly consumed in the form of vegetables or soup and developed into a product.[10] The iron content in bangun-bangun leaves was quite high, 13.6 mg per 100 grams, higher than spinach, 3.5 mg per 100 grams. Most anchovies in their processing go through a salting and drying process, the end result of which was a product in the form of dried salted anchovies.[11] The processing of anchovies had not progressed much. Most anchovies were processed into side dishes such as pepes, bebothok, or simply fried.[12] Therefore, in this study the author wanted to create anchovies as a mixed ingredient in making biscuits that were consumed as a snack.

There is no government program related to supplementary food for adolescent girls to prevent or overcome anemia. Supplementary foods and or snacks that are rich in nutrients can meet

the nutritional needs of adolescents, especially iron intake. So, it is necessary to innovate additional food in the form of biscuits that can be accepted by adolescent girls to increase iron intake to prevent anemia. This study aimed to determine the selected formulation, the effect of adding bangun-bangun leaves and anchovies to biscuits and the iron content in biscuits.

Methods

This research was conducted in several stages, namely determining biscuit formulations, making biscuits, descriptive tests and hedonic tests on biscuits, iron analysis on biscuits, determining selected biscuits. This study used an experimental research design with the Completely Randomized Design (CRD) method which aimed to determine the effect of certain treatments on others and under controlled conditions. Based on the calculation of treatment repetition, the results were repeated 6 times so that 24 food samples were obtained. Each formulation produced biscuits with a unit weight of 20 grams. Here were 4 biscuit formulas used in this study:

Table 1. The Ingredients for Bangun-Bangun Leaf Biscuit and Rice Anchovy Formulation

Ingredients	Control/F0 (gr)	F1 (gr)	F2 (gr)	F3 (gr)
Flour	100	85	70	60
Bangun-bangun leaves	-	5	10	15
Anchovies Flour	-	10	20	25
Raisins	-	5	5	5
Margarine	50	50	50	50
Egg yolk	20	20	20	20
Granulated Sugar	70	70	70	70
Milk Powder	25	25	25	25
Baking powder	1	1	1	1
Vanilli	1	1	1	1

Source: Gaol Modification (2019)

Biscuit making was done in the culinary laboratory of the Faculty of Public Health, Sriwijaya University. The steps for making bangun-bangun leaf slices were to wash the bangun-bangun leaves thoroughly, then drain them until dried and sliced them thinly using a knife.[13] Meanwhile, the making of anchovy flour was done by washing the anchovy until clean, then draining and drying it used an oven at a temperature of 100 ° C for 100 minutes. After drying, the anchovy was blended until smooth and sieved using an 80 mesh sieve. The making of biscuits began by mixing margarine, powdered sugar and powdered milk, then mixed with egg yolks, vanilla and baking powder. After mixing, add wheat flour, sliced bangun-bangun leaves, anchovy flour and raisins. The dough that had been evenly mixed was molded into a circle with a diameter of 7 cm and the top was pricked and then baked using a temperature of 125℃ for 20 minutes.[1314]

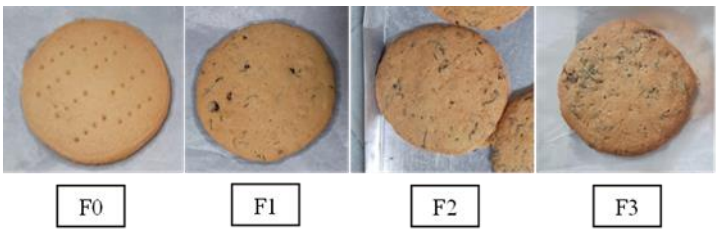
Descriptive test and hedonic test were conducted by 25 panelists who were students of the Nutrition Study Program, Faculty of Public Health, Sriwijaya University with qualifications of having received material on organoleptic tests. Hedonic test was conducted by panelists regarding personal responses to bangun-bangun leaf biscuits and anchovy rice which focused on the level of

preference for color, aroma, taste, and texture. The assessment was carried out by providing a checklist on the hedonic test form with the criteria of very much like, like, somewhat like, dislike, and very much dislike. While the hedonic quality test focused on the level of biscuit quality with indicators; color (dark brown, light brown, greenish brown, light green, dark green), aroma (very not fragrant, not fragrant, somewhat fragrant, fragrant, very fragrant), taste (very not savory, not savory, somewhat savory, savory, very savory), texture (very not crispy, not crispy, somewhat crispy, crispy, very crispy). Testing of iron content in biscuits was conducted at the Che-Mix Pratama Laboratory, Yogyakarta.

The selected formulation in this study was calculated based on the hedonic test value and iron content value, each value was given a weight of 50%, comparing the formulations that were subsumed with bangun bangun leaves and anchovy flour, namely formulas F1, F2 and F3. The results of the study were analyzed using the Kruskall-Wallis test and continued with the Mann-Whitney test to determine the effect of adding bangun-bangun leaves, anchovies and raisins to biscuits. The data were presented in the form of tables and graphs and then described. This study had obtained ethical clearance from the Health Research Ethics Commission of the Faculty of Public Health, Sriwijaya University Number: 133/UN9.FKM/TU.KKE/2024 March 25th, 2024.

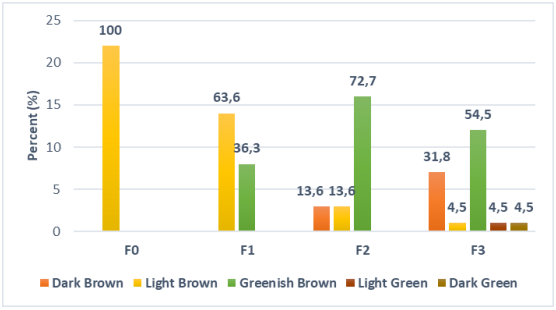
Results

Biscuits were dry cake products that were used as snacks or snacks. In this study, biscuits had a round shape with a diameter of 6-7 cm and have small holes. In this study, there were 4 formulations of bangun-bangun leaf and anchovy rice biscuits with different amounts of bangun-bangun leaf and anchovy rice substitutions. The appearance of the 4 biscuit formulas were seen in Picture 1 below:

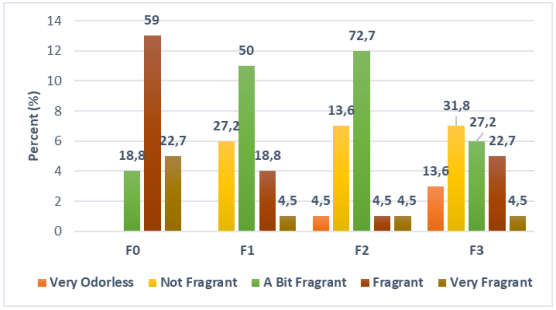


Picture 1. Bangun-bangun Leaf Biscuits and Anchovy Rice

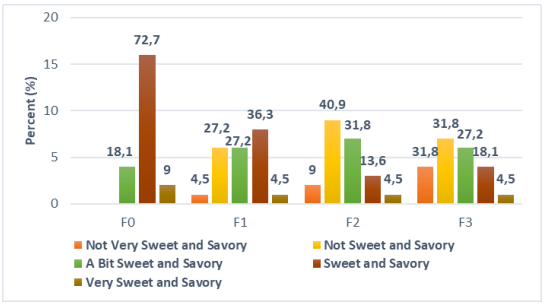
Descriptive tests were conducted on the products of leaf bangun-bangun biscuits and anchovy rice which aimed to determine whether there were differences in each formulation in terms of color, taste, aroma and texture. This descriptive test was conducted using 5 assessment scales for each indicator. The description test of the color, taste, aroma and texture of the biscuits can be seen in chart 1 below:



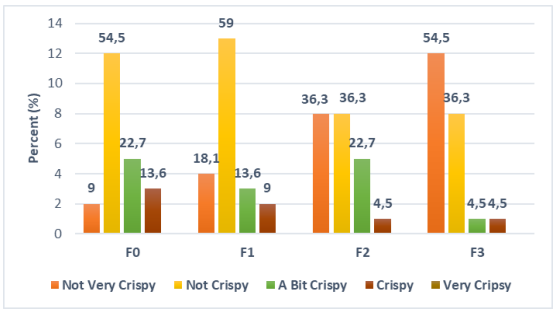
Color



Fragrant



Taste



Texture

Chart 1. Descriptive Test of Bangun-bangun Leaf Biscuits and Anchovy Rice

Based on the descriptive test on biscuits against color, the results showed that most panelists stated that formulas F0 and F1 were light brown, while formulas F2 and F3 were greenish brown. Most panelists stated that the aroma of formulation F1 was fragrant, formulations F1 and F2 were slightly fragrant while formulation F3 was not fragrant. Panelists stated that the taste of formulation F0 was very sweet and savory, while for other formulations it varied. Most panelists stated that formulations F0, F1, F2 were not crunchy while formulation F3 was not very crunchy.

The hedonic test or level of preference conducted on the products of bangun-bangun leaf and anchovy biscuit in this study, aimed to determine the selected formulation from the four formulations that had been determined, starting from F0, F1, F2, and F3. The hedonic test conducted includes color, aroma, taste and texture with an assessment scale starting from a score of 1 which meant very dislike, a score of 2 which means dislike, a score of 3 which meant rather like, a score of 4 which meant like, to a score of 5 which means very like.

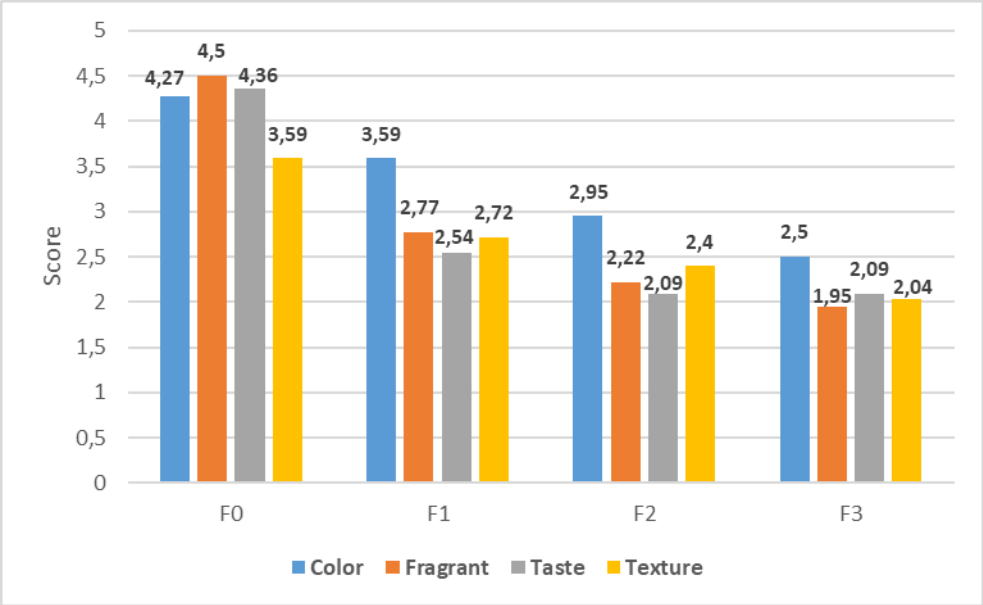


Chart 2. Hedonic Test Results

Based on the Kruskal-Wallis Test, the results obtained were p<0.05, which meant that there was a significant difference between the F0, F1, F2, and F3 treatments on the level of biscuit preference. Furthermore, the Mann-Whitney test was used to compare the two formula groups. Furthermore, the Mann-Whitney test was carried out which aimed to compare two independent groups, the test results were seen in table 2 below.:

Table 2. The Analysis of Differences between Two Formulation Groups

Formulation	Nilai Signifikan			
	Color	Fragrant	Taste	Texture
F0 & F1	0,008	0,000	0,000	0,001
F0 & F2	0,000	0,000	0,000	0,000
F0 & F3	0,000	0,000	0,000	0,000
F1 & F2	0,009	0,027	0,102*	0,270*
F1 & F3	0,000	0,003	0,111*	0,006
F2 & F3	0,052*	0,161*	0,804*	0,057*

*there is no significant difference at level 5%

Based on Table 2, the results showed that in the color parameter, only samples F2 and F3 did not have a significant difference, indicated by a significant value of 0.052, while other samples show a significant difference. For the aroma parameter, it ias known that only F2 and F3 did not have a significant difference, while other formulas had a significant difference. Furthermore, the taste parameters F0 and F1, F0 and F2, and F0 and F3 had a significant difference with a significant value of 0.000. While for the texture parameter, it was known that F1 with F2 and F2 with F3 show a significant value > 0.05, which meant there was no significant difference, while other formulations showed a significant difference.

The selected formulation in this study was calculated based on the hedonic test value and the iron content value, each value of which was given a weight of 50%, comparing the formulations

substituted with bangun bangun leaves and anchovy flour, formulas F1, F2 and F3. Based on the calculation using weighting on each formula, formula F3 had the highest value of 3.02, followed by formulation F1 with a value of 2.95 and F2 with a value of 2.89. So, the selected formula was F3 biscuits with the addition of 15 grams of bangun bangun leaves and 25 grams of anchovy flour.

Table 3. Iron Content and Iron Adequacy Levels in Adolescents

Formulation	Iron content per 100 grams	Iron Content per Serving Size 20 gr (1 piece)	AKG Iron for Girls Age 13-18 years /day *	Need for snacks (15%)	Iron Replenishment
F0	8,11 mg	1,62 mg	15 mg	2,25 mg	72 %
F1	9,22 mg	1,84 mg	15 mg	2,25 mg	82 %
F2	10,19 mg	2,03 mg	15 mg	2,25 mg	90 %
F3	11,7 mg	2,34 mg	15 mg	2,25 mg	104 %

*Source: *Permenkes, 2019*

Based on Table 3, the results showed that the highest iron content was in F3 biscuits, so the adequacy of iron per day as a snack was also in F3 biscuits. If teenage girls consumed 1 to 2 biscuits, it would fulfill 15% of the AKG for girls aged 13-18 years obtained from snacks.

Discussion

Color was the first impression that appears on food. Color referred to the visual characteristics of food as assessed by the human sense of sight. Color ias one of the important factors in the acceptance or rejection of a product.[8] The color of food must have an attractive impression so that it was considered delicious and was consumed by consumers, not only because of the high nutritional content, but also the appearance of the color of a product so it could be enjoyed.[16] In this study, based on the descriptive test of biscuits on color, the results showed that most panelists stated that formulas F0 and F1 were light brown, while formulas F2 and F3 were greenish brown. The difference in color was caused by the concentration of wheat flour, bangun-bangun leaves and anchovies and the baking process on the biscuits. The more anchovies added, the darker the color of the biscuits. Similarly, the more bangun-bangun leaves added, the more greenish the color produced on the biscuits. The addition of anchovy flour causes brown pigments to form due to the Maillard reaction. This occurred because of the reaction of lysine and simple sugars found in anchovy flour and skim milk.[17] Meanwhile, the greenish color of the biscuits was caused by the addition of sliced bangun-bangun leaves that contain chlorophyll. The greener the color of the leaves, the higher the chlorophyll content.[18]

The fragant of a product was detected when volatile substances were inhaled and received by the human sense of smell.[17] Odors received by the nose and brain are generally a mixture or concoction of four kinds of odors: sour, charred, rancid and fragrant.[19] Most of the panelists in this study stated that the F1 formulation was fragrant, F1 and F2 formulations were slightly fragrant

while F3 formulation was not fragrant. The aroma was influenced by the presence of anchovy flour which caused a fishy aroma. Fishy odor was a typical aroma associated with fish, which was produced by nitrogen components such as guanidine, Trimethyl Amine Oxide (TMAO), and imidazole derivatives.[17] The aroma produced in biscuit products came from the fat used. This study used margarine which was classified as vegetable fat. Fat was also an important component in making biscuits because it had a role as an aroma enhancer, with the addition of this fat the aroma of bangun-bangun leaves were covered.[20]

Taste was the sensation felt by the tongue and taste buds when eating or drinking. It involved the perception of the chemical properties of food involving sweet, sour, bitter, and umami.[21] Panelists in this study preferred the F1 formulation with the addition of bangun-bangun leaves, anchovies in the smallest amount among the other formulations. It were concluded that the higher the addition of bangun-bangun leaves and anchovy flour, the lower the overall acceptability and preference level of the biscuits. The taste produced by adding anchovy flour to the biscuits, with the increasing composition of anchovies put into the dough, the biscuits tasted saltier. This was because there was a decrease in water content during the baking process. Heat caused the water in the fish to evaporate, so that the water content decreased and the salt concentration in the fish increased, making it tasted saltier.[22]

Biscuits were a type of dry cake that required low water content to achieve a crispy texture. The lower the water content in the biscuit, the crispier the texture. The low water content in these biscuits was produced by the oven temperature during the baking process. The baking treatment of biscuits in the oven aimed to obtain a crispy texture [23]. Most of the panelists in this study stated that the F0, F1, F2 formulations were not crispy while the F3 formulation was very not crispy. The difference in texture in each formulation is in line with the research of Aminah (2016) which stated that the amount of fortifying material (bangun-bangun leaves) added to biscuit dough had a maximum limit of 15% of the weight of the flour used. Adding bangun-bangun leaves more than 15% created a soft dough texture and was difficult to mold into biscuit pieces.[24] The resulting texture was influenced by the fat content (margarine) in the biscuits, because the fat itself functioned as a shortening so that the resulting biscuits have a soft texture.[20]

Iron was needed for cell growth, oxygen binding and transport, enzymatic reactions, immunity, cognitive function, and mental and physical growth. There were various causes of iron deficiency and iron deficiency anemia in adolescent girls, including inadequate intake or poor absorption of iron, increased needs during adolescence, significant blood loss during menstruation, parasitic infections, and so on.[25] Since 2014, the Government of Indonesia has implemented efforts to prevent and overcome anemia among adolescent girls through the provision of **Blood Supplement Tablets** or Iron Folic Acid (IFA).[26] **Blood supplement tablets** are one of the supplements for adolescent girls in addition to food supplements.[7] Currently, there is no

government program related to supplementary food for adolescent girls in Indonesia. Based on previous research, one of the interventions that can be done to prevent anemia in adolescent girls is the provision of additional food or certain supplements.[27]

Bangun-bangun leaf and anchovy rice biscuits were intended as snacks. As a snack, biscuits should be consumed between breakfast and lunch (at 10:00 WIB) or between lunch and dinner (at 16:00 WIB). In this study, the highest iron content was in the F3 formulation while the lowest was F0. The higher the addition of bangun-bangun leaves and anchovy rice, the higher the iron content in the biscuits. The results of this study were in line with previous research that the addition of bangun-bangun leaves had been proven to influence the results of the analysis of iron content in biscuit products, because bangun-bangun leaves contained quite high levels of iron.[13] These biscuits were formulated as a snack which, when consumed, would contribute 10-15% of iron intake compared to total daily requirements. This study is limited to the iron content of F3 biscuits, which is the selected formulation. Further research is needed to determine the effect of biscuit administration on the incidence of anemia in adolescent girls.

Conclusion

Based on the results of the hedonic test, F3 biscuits were the most preferred formula compared to other formulations. Based on statistical tests, data was obtained that there was a significant difference ($p < 0.05$) between the color, aroma, taste and texture of all formulas. The results of laboratory tests showed that the more bangun-bangun leaves and anchovies were added, the higher the iron content in the biscuits. By consuming F3 biscuits as additional food, it met the iron needs of adolescent girls, which was 15% of the total daily requirement. These biscuits can be an alternative substitute for snacks for adolescent girls to meet their iron intake needs so that they can prevent anemia.

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Conflict of Interest There

There is no conflict of interest for the authors in this research.

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