

Utilization of *Ulva Lactuca* As An Alternative to Increase Iron Youth

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Abstract:

The incidence of anemia in adolescent girls in Indonesia is still relatively high. Anemia can occur because young women experience menstruation every month. This can reduce the quality of health and life. One of the efforts to increase the consumption of iron sources can be done by processing interesting foods with the use of local food ingredients. Seaweed is a biological plant that is widely found in Indonesian waters, one of which is *ulva lactuca* seaweed. This seaweed is found on the beach along Kukup, Yogyakarta. Utilization of seaweed type *ulva lactuca* can be used as a side dish, namely grilled rice with additional processed tuna fish. This study aims to analyze the nutritional content in the form of proximate and iron tests as well as organoleptic tests on roasted rice, seaweed, *ulva lactuca* and processed tuna. This research method uses research and development methods (Research and Development) with a 4D model. This research consists of the process of making roasted rice using black rice, *ulva lactuca* seaweed, processed tuna and broccoli. The results of the analysis of the content of water, ash, fat, protein, carbohydrates, crude fiber and calories per 100 g were 61.50, 1.66, 7.03, 9.87, 20.03, 0.31% and 170 respectively kcal, while the iron content is 49%. This grilled rice can be accepted by the panelists with a score of 4.8 on the overall trait. In conclusion, *ulva lactuca* seaweed and processed tuna can be used in the manufacture of baked rice which contains seaweed in it.

Keywords: *iron, nutrient content, preference test, roasted rice, Ulva Lactuca*

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Introduction

In adolescents, changes are taking place in the form of physical, cognitive and psychosocial that take place so quickly (Rachmayani et al., 2018). Fulfillment of good nutrition can affect brain performance and can avoid anemia (Aini et al., 2020). Anemia is generally experienced by a group of adolescents, especially those who are female because they are in the growth phase. Adolescent girls also experience menstruation every month. During menstruation, adolescent girls can bleed a lot. This can cause loss of iron in the body. Iron in the blood is also lost up to 10%, so iron deficiency can occur (Nasruddin et al., 2021).

Anemia is a condition where the number of red blood cells in the body is lower than normal. This can cause the body to not get enough oxygen so it cannot function normally. Anemia is a condition where the *Hemoglobin* (Hb) level in the blood is lower than the normal level for a group of people based on age and gender. In adolescent women, the normal HB level is 12-15 gr/dl and in adolescent men it is 13-17 gr/dl (Adriani & Wirjatmadi, 2017). The main causes of anemia are generally due to lack of knowledge about anemia itself, lack of iron, folic acid, vitamin B12 and vitamin A.

The incidence of anemia in adolescent girls can cause fatigue, decreased concentration on learning so that it will affect learning achievement and can reduce work productivity. The high prevalence of anemia among adolescents if not handled properly will continue into adulthood and will contribute greatly to maternal mortality, babies born prematurely and babies with low birth weight (Novelia et al., 2022).

According to WHO data (2013) in (Nurjanah et al., 2018) that the current anemia of adolescent girls is still high, its prevalence in the world is 40-88%. Riskesdas (2013) explains that 21.7% of Indonesians who suffer from anemia are aged 15-24 years, namely 18.4%. Anemia in Indonesia is usually caused by reduced iron (Fe) which is often said to be iron deficiency anemia (Damayanti et al., 2020). This occurs due to iron deficiency in the blood due to disruption of red blood cell production due to the lack of iron content in the blood. Anemia causes symptoms such as fatigue, weakness, dizziness and shortness of breath.

Currently, the incidence of anemia in adolescents has received attention from the government because Indonesia ranks 4th out of the top 10 cases of anemia (Priyanto, 2018). The quality of health, especially in adolescent girls, is the basis for the growth of the nation's next generation. The incidence of anemia in adolescent girls cannot be underestimated because the quality of genes from ancestors will affect the fetus of newborn grandchildren. In addition, adolescents with anemia will affect their concentration, memory, and academic performance.

In addition, according to Harahap (2018), anemia can have an impact on adolescents, namely a decrease in body resistance so that they will be more susceptible to disease, decreased activity and learning achievement. And also these adolescents will experience a decrease in fitness to cause decreased sports performance and productivity.

Anemia is very influential on life, especially adolescent girls who are growing and active in activities. Lack of adequate nutritional intake with dense activities can hinder sustainable growth. So the importance of adequate nutritional intake is one of them with processed foods that can increase iron in the body.

A survey of 1,500 adolescent girls in Yogyakarta Province found that 19.3% of adolescent girls suffer from anemia (Yogyakarta Special Region Health Office, 2018). It can be assumed that iron deficiency is experienced by adolescent girls in Indonesia with a ratio of 1 in 5. Mothers who are pregnant with anemia are dangerous to give birth to babies with low birth weight and can be a factor in the emergence of several diseases the next day.

Efforts to overcome iron deficiency can be pursued by providing foods that are high in iron. Sources of iron are obtained from plant and animal food sources. Other sources of iron found in vegetable products include green vegetables such as spinach, broccoli and yellow apricots. Eggs, fresh red meat such as beef come from animal products (Fuada et al., 2019). The process of iron absorption in vegetable materials must be assisted by one of them with vitamin C, because it can change the absorption of iron (Nasruddin et al., 2021). Increasing iron intake can also be done by processing foods that are attractive to teenagers by utilizing local ingredients, such as seaweed.

Seaweed or algae is one of the main commodities of aquaculture in Indonesia. Seaweed is a source of biological energy in Indonesian waters. There are 8.6% of the existing marine biota. The area of seaweed reaches 1.2 million hectares in Indonesia and is the largest in the world (Suparmi & Sahri, 2009). *Ulva Lactuca* is a type of seaweed that can be found on the beach along the Kukup sea, Yogyakarta. It has 46-51% carbohydrates, 18.7% water, 16-23% ash, 0.1-0.7% fat, 15-26% protein, 2-5% fiber, and has vitamins B1, B2, B12, C and E per 100 grams of net weight.

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Ulva lactuca type seaweed can be utilized into interesting preparations, especially for young women. Interesting preparations can be favored by teenagers (Santoso et al., 2018). One of them is black rice baked rice with processed tuna fish to increase iron in the body. Protein, vitamin and mineral levels in black rice are higher than ordinary white rice. Black rice has essential amino acids such as lysine and tryptophan, vitamin B1, vitamin B2, folic acid and mineral sources such as iron, zinc, calcium, phosphorus and selenium (Sudarwati, 2020).

It is a species of seaweed that is bright apple green in color and folded sword-shaped with smooth but wavy edges. *Ulva lactuca* can grow well in a wide range of temperatures and salinities and is often found on beaches based on dead coral, especially on coral reef flats. This algae is easily detached from the substrate so it will be easily found on the beach. Utilization of this seaweed is usually limited to nori products, peyek and chips (Nurjanah et al., 2018). *Ulva lactuca* contains 16 types of amino acids, one of which is glutamic acid which is a compound that can be used for flavor enhancement in food. *Ulva lactuca* also contains bromophenol, a compound that causes a "sea" odor or smells like shrimp or seafood.

Some previous research results show that mixing seaweed flour and wheat flour has a high iron value (Budiyono & Candra, 2013). Other research also shows that consuming processed seaweed can overcome anemia in pregnant women (Damayanti et al., 2020). The processing of *Ulva Lactuca* seaweed baked rice with tuna and black rice has never been done and developed. Researchers intend to conduct research to find the right recipe for making *Ulva*

Lactuca seaweed baked rice, find out the public acceptance and find out information on the nutritional value contained in *Ulva Lactuca* seaweed baked rice .

The main text format consists of a flat left-right column on A4 paper. Text margin from top and bottom is 2 cm, right and left is 2.5 cm. The manuscript is written in Microsoft Word, single space, Times New Roman 10pt and maximum 12 pages. The title of the article should be the fewest words that accurately describe the contents of the paper. Indexing and depreciation services depend on the accuracy of the title, extracting it from useful keywords in cross-reference and computer search.

Research Method

Materials

The main ingredient that will be processed in the baked rice is *Ulva Lactuca* seaweed obtained from the sea along Kukup, Yogyakarta. Other ingredients include organic black rice, tuna meat, broccoli, margarine, garlic, red chili, lime leaves, lemongrass, brown sugar, salt and sesame seeds.

Methods

The research and development design used R&D for product development by innovating baked rice. The research model uses 4D which consists of: *Define*, search and find basic recipes from various sources. Conduct experiments by comparing the three recipes to get the best recipe standard for *Ulva Lactuca* seaweed baked rice ; *Design*, design and develop products by changing white rice to black rice and adding *Ulva Lactuca* seaweed to baked rice; *Develop*, validate or assess the feasibility of the product to 2 expert lecturers in the field of boga. The results of the assessment were used to improve the product; *Disseminate*, conduct a wide-scale favorability test and conduct proxima and Fe nutrient content tests in the laboratory.

The research was conducted from October to January 2021, which began with making black rice and processed *Ulva Lactuca* seaweed and tuna fish. Organoleptic analysis was carried out using the parameters of color, taste, aroma, texture, and overall properties by conducting nutritional analysis, namely proximate testing in the form of fat, protein, water, and carbohydrate levels at TPHM UGM. In addition, iron (Fe) content was tested at LPPT UGM.

Preparation of roasted rice

The process of making roasted rice starts from weighing black rice and water in a ratio of 1: 3 and then soaking for 2.5 hours then cooking using a *rice cooker* (Tang et al., 2016). The next stage is *Ulva Lactuca* seaweed and broccoli that are not rotten with uniform color. Wash the seaweed and broccoli using hot water to remove dirt and saltiness of the seaweed. Drain the seaweed and then clean it again with running water to remove any dirt. Mince the seaweed and broccoli. Saute the seaweed and broccoli separately with margarine and salt and pepper. Pureed spices are garlic, red chili and shallots then stir-fried along with cleaned and diced tuna. Add lime leaves and lemongrass as well as pepper and salt. Weigh the rice with a weight of 90 g, add 5 g margarine and mix well. Put into aluminum foil cup, flatten. Weigh 20 g seaweed, 10 g broccoli, 30 g tuna. Place on the aluminum foil cup in a stack. Sprinkle with sesame seeds and bake for 10 minutes in the oven at 150°C. The process of making this food preparation uses white rice as a reference recipe while the development recipe uses black rice to increase the nutritional content of baked rice. While the tuna fish used in the development recipe is 50 grams, this is because there are additional ingredients, namely *Ulva Lactuca* seaweed as much as 40 grams which are not found in the reference recipe. The reference recipes are listed in Table 1.

Table 1 Reference recipe and development

Ingredients	Reference Recipe	Development Recipe
White rice	200g	-
Black rice	-	200g
Butter	50g	50g
Tuna fish	150g	50g
<i>Ulva Lactuca</i> seaweed	-	40g
Broccoli	50g	50g
Chili	3 pcs	3 pcs
Garlic	3 cloves	3 cloves
Shallot	3 grains	3 grains
Lime leaves	-	2 pcs
Lemongrass	1 batang	1 bars
Salt	½ tsp	½ tsp
Pepper	¼ tsp	¼ tsp

Source: Chynthiahali (2020)

Recipes are selected according to the characteristics of the product. The reference recipe above has good texture and flavor. There is a slightly spicy savory taste, the texture that comes from broccoli has a distinctive aroma of tuna and the result of roasting and has a brown color. The substitution process was carried out on white rice with black rice with three comparison recipes, namely 50%, 75%, 100% black rice in 100 grams of white rice. The result of this stage is to use a recipe that uses 100% black rice because the taste and texture are well received.

Organoleptic analysis

Organoleptic test analysis with hedonic test form product testing. The test assessment uses the scoring method. The research respondents were 100 semi-trained panelists from adolescent girls aged 16-18 years. The test used with the 5-scale hedonic test includes (1) very dislike, (2) dislike, (3) somewhat like, (4) like, (5) very like. The product is acceptable if the hedonic test results have a scale > 2 (Suryono *et al.*, 2018). This organoleptic test was conducted to obtain the acceptability of baked rice and the selected formula. Panelists can fill out forms and provide responses to the products developed.

Iron analysis

Analysis of iron content in this study was carried out using the *Atomic Absorbent Spectrophotometry* (AAS) method. This method is done by putting 1 g of sample dissolved in 5 mL of HNO_3 . The solution was heated until all the ash dissolved on a *hot plate*. In the flask, the solution was diluted with aquabides in a dose of 10 mL up to the mark (Astuti *et al.*, 2014).

Statistical analysis

The data obtained then entered the next process, namely analysis with Microsoft Excel 2019. Data were also analyzed using *SPSS* to determine the level of liking for the reference product. Nutritional content and organoleptic data were analyzed using *paired t-test* at a significant level of 5%.

Result and Discussion

Organoleptic test results

This research began by conducting a limited scale organoleptic test and developed into a wide scale. Organoleptic test is a test that is carried out subjectively, namely through the five human senses (Salman *et al.*, 2018). Organoleptic test by testing the reference product, namely baked rice from white rice and *Ulva Lactuca* seaweed black rice baked rice development product. The results of the favorability test with 100 untrained panelists using forms to assess *Ulva Lactuca* baked rice products. There is code 357 as a reference and 461 as a substitution. The results of product form 357 have an overall result of 3.6 or somewhat favorable. The substitution product with code 461 has an overall test result showing that young women prefer the *ulva lactuca* and tuna baked rice development product compared to the reference recipe baked rice.

The organoleptic test results (Table 2) explained that the development product was preferred by the panelists, seen in the parameters of texture, color, taste, aroma, and overall. The addition of *Ulva Lactuca* seaweed to the development product makes the color of paggang rice more attractive. Color is one of the factors that need to be mastered in serving food. The use of attractive colors can provide and arouse appetite (Kusumaningrum & Supradewi, 2019). The *paired t-test* test provides results in the color parameter. This explains if the color inequality of the reference product and the developed one. So, the product development of baked rice with *Ulva Lactuca* seaweed is acceptable to panelists. The results of the organoleptic test on both samples can be seen in Table 2.

Table 2 The results of the organoleptic test analysis of roasted rice on the reference product and product development

Parameter	Reference	Development
Colour	3,48±0,61 ^b	4,75±0,44 ^b
Fragrance	3,63±0,55 ^b	4,58±0,50 ^b
Flavor	3,60±0,55 ^b	4,65±0,50 ^b
Texture	3,58±0,59 ^b	4,61±0,49 ^b
Overall	3,62±0,55 ^b	4,79±0,41 ^b

Note: different superscripts in the same line showed significant differences ($p < 0.05$) using the paired *t-test*

Based on the organoleptic test results above, it can be seen that the color parameter in the development product has a higher value than the reference product. Likewise with the aroma, flavor and texture parameters. Overall, the development product is acceptable because the development product results show a higher value than the overall parameters in the reference product. The addition of *Ulva Lactuca* seaweed to the developed product makes the color of paggang rice more attractive. This can affect the acceptability of the level of public liking because color, taste, aroma and texture of food are important factors that must be considered (Iswendi et al., 2019). Color is one of the factors that need to be mastered in serving food. The use of attractive colors can provide and arouse appetite (Kusumaningrum & Supradewi, 2019). The *paired t-test* test provides results in the color parameter. This explains if the color inequality of the reference product and the developed one. So, the product development of baked rice with *Ulva Lactuca* seaweed is acceptable to panelists.

Aroma is the most difficult assessment of organoleptic tests (Misnaiyah et al., 2018). The addition of *Ulva Lactuca* seaweed in the toasted rice development product had an impact on the aroma obtained by the panelists. The *paired t-test* explained the dissimilarity of aroma in the reference product and the developed one. This is due to the addition of *Ulva Lactuca* seaweed.

Flavor and texture also influence consumers on food. Processed food is often given additional ingredients to improve flavor (Nasution & Lesmana, 2018), as is done in the development product by adding citrus leaves to baked rice which makes the taste not fishy due to the use of tuna and seaweed. The use of black rice in baked rice can arouse appetite because of its deep dark color. Black rice in development products can also affect texture (Hidayat et al., 2019). Based on the *paired t-test* test, the results show that there is an inequality in taste and texture in the reference and developed products. In addition, in its overall properties if there is a difference between the product before being developed and after being developed.

Proximate test results

The results of the analysis of water content (Table 3) explain the high water content in the development product because the seaweed processing is not so long. This is in line with research by Ihsan (2020) that fresh seaweed has a high content of water. The development product uses seaweed which produces a high ash content. This is because seaweed lives in sea waters which are rich in minerals (Diki et al., 2020). In accordance with the opinion of Farid *et al.* (2013) variations in total minerals, large organic components at the bottom of the water and its depth, distance from the ground, and the environment affect the amount of seaweed minerals. The results of the proximate nutrient content test analysis can be seen in Table 3.

Table 3. Proximate test results on development products

Nutritional Content	Average
Water (%)	61,50
Ash (%wb)	1,66
Fat (%wb)	7,03
Protein total (5wb)	9,87
Carbs by diff (%wb)	20,03
Coars fiber (%wb)	0,31
Calories (kkal/100 g)	170

Source: food technology and agricultural product testing laboratory

Based on the table above, the nutritional content of processed pangang rice using *Ulva Lactuca* seaweed has a moisture content of 61.5%, ash 1.66%, fat 7.03%, total protein 9.87%, carbohydrates 20.03%, crude fiber 0.31% and has a total calorie count of 170 kcal. In the results of the analysis of fat content, the development product does not have such high fat. This is because seaweed does not have much fat content. The protein content of a food can be influenced by the processing process. One of the causes of decreased protein content in food is the heating process. The high carbohydrate value in the development product is due to the addition of seaweed. The proportion of seaweed in the product is thought to have an influence on product results because seaweed is the largest carbohydrate producer (Diki et al., 2020).

Heating proteins can cause both expected and unexpected reactions. These reactions include denaturation, loss of enzyme activity, changes in moisture and hydration, color changes, derivatization of amino acid residues, *cross-linking*, peptide bond breaks and the formation of sensorially active compounds. This reaction is influenced by temperature and duration of heating, pH, oxidizers, antioxidants, radicals and other active compounds, especially carbonyl compounds (Astuti et al., 2014).

Nutritional value information

After laboratory testing in the form of proximate tests and iron tests, the next step is to describe the nutritional content contained in the development product. The exposure aims to provide nutritional value information on the development product label. The exposure of nutritional content will be equated to the required Nutritional Adequacy Rate (AKG). The development product is targeted at adolescent girls aged 16-18 years. The nutritional content has clear information from laboratory testing and is presented in accordance with the AKG of the general category. The results of the nutritional information can be found in Figure 1.

NUTRITIONAL VALUE INFORMATION		
Serving size 150 g		Netto 150g
1 Serving of package		
QUANTITY OF SERVING		
Total Energi		255 kkal
Energy From Fat		63 kkal
		%AKG*
Total Fat	11 g	23%
Protein	15 g	19%
Carbohydrates	30 g	87%
Iron	7,3mg	49%
* Percentage of RDA based on an energy requirement of 2100 kcal. Your energy needs may be higher or lower		

Figure 1. Nutritional value information

Based on the nutritional value information table above, it can be explained that processed baked rice using *Ulva Lactuca* seaweed with a serving size of 150 grams has a total energy of 255 kcal. While energy from fat has a value of 63 kcal. Total fat is 11 grams, protein is 15 grams, carbohydrates are 30 grams and iron is 7.3 mg. The results of the analysis of iron content in the development product were 49%. Iron has several essential functions in the body, namely as a means of transporting oxygen from the lungs to body tissues, transporting electrons into cells and helping enzymes in body tissues. This substance is needed to form red blood cells and plays a role in the formation of myoglobin, collagen and enzymes. In addition, iron also functions in the body's defense system (Sudargo et al., 2018). Food sources of iron are associated with proteins (*heme*) and as complex organic iron compounds (*non-heme*). *Heme* comes from

animal foods such as meat, fish, liver, eggs and milk. While *non-heme* comes from plant foods such as beans, green leaf vegetables, fruits and cereals (Fuada et al., 2019).

Iron is the most abundant micro mineral in the human and animal body, which is as much as 3-5 grams in the adult human body. Although it is abundant in food, many people in the world experience iron deficiency, including in Indonesia. Iron deficiency has been recognized since the last thirty years to affect work productivity, cognitive performance and the immune system (Salman et al., 2018).

According to Palupi (2010), environmental factors that affect iron damage include heat, air, light and humidity, especially for copper, iron and zinc. The stability of iron depends on several factors including the nature of the carrier material, particle size and exposure to heat, humidity and air. The high iron content in baked rice using *Ulva Lactuca* seaweed can be used as an alternative *one dish meal* for adolescent girls to increase iron. The following idea is in line with Damayanti's (2020) research that consuming seaweed can overcome anemia. The protein contained in the development product is 19%. Fulfillment of protein in adolescents is needed to help growth and development (Sholicha & Muniroh, 2019). In line with the results of research by Mutiara et al. (2021) consuming seaweed diligently will have an impact on increasing hemoglobin levels in anemia sufferers. Researchers assume that non-pharmacological drugs in anemia should be given to pregnant women affected by anemia, because materials that are easily obtained and consumption for a long time also do not affect the health of mothers and children.

The normal fat requirement is 20-25% of all nutritional needs. The fat in the development product is 23%, so the development product can be consumed according to the required fat. Carbohydrate in the development product has a content of 30 g or 87%, while the carbohydrate requirement for women aged 16-18 years is 292 g per day. This development product can be consumed as a *side dish*.

Conclusion

The product development of baked rice using black rice, tuna fish and *Ulva Lactuca* seaweed can be accepted by panelists. The product can be used as an alternative food to increase iron in adolescent girls. This research was not conducted periodically so it is not yet known that the development product can increase iron in adolescent girls, this can be used as future research.

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