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NUTRITIONAL ANALYSIS OF SEAWEED CHIPS AS AN EFFORT TO REDUCE ANEMIA IN ADOLESCENT GIRLS

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ABSTRACT
Adolescence is a critical period that is vulnerable to health issues, including anemia, which is triggered by deficiencies in iron, folic acid, and vitamin C. This study aims to analyze the nutritional content of seaweed chips as an alternative snack to combat anemia in adolescent girls. Using an experimental design, two variants of seaweed chips (original and spicy) were analyzed for their macro- and micronutrient content, including protein, iron, folic acid, and vitamin C. The results showed that the original chips contained an average of 7.1% protein and 39.97 µg/g of iron, while the spicy chips had a higher vitamin C content (67.1%) but lower iron levels (33.1 µg/g). The folic acid content in both variants was very low (<0.25 mg/kg). Nevertheless, the high vitamin C content in the spicy chips can enhance iron absorption, supporting efforts to prevent anemia. Although these seaweed chips cannot be relied upon as a primary source of protein or folic acid, they offer a healthy, low-calorie snack alternative.

Keywords: adolescent girls; anemia; iron (Fe); seaweed chips

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INTRODUCTION

Adolescence is a period vulnerable to health risks, as the body undergoes rapid growth and requires adequate nutritional intake (Manay, 2019). However, many adolescents still lack an understanding of the importance of meeting these nutritional needs. Adequate nutrition is often neglected, potentially leading to health issues such as anemia. Anemia affects about one-third of the world's population, with half of the cases caused by iron deficiency (Kusnadi, 2021). Iron plays a vital role in various physiological functions, and its deficiency can lead to fatigue, difficulty concentrating, heart palpitations, and dizziness (Lopez et al., 2016). In severe cases of iron deficiency anemia, this condition can cause tachycardia, ankle edema, and even heart failure. Research shows that women with iron deficiency experience lower physical and mental well-being compared to women without iron deficiency (Mirza et al., 2018).

According to data from the World Health Organization (WHO), the global prevalence of anemia ranges between 40-88%. In Southeast Asia, around 25-40% of adolescent girls suffer from anemia, ranging from mild to severe levels (Wardhani & Wahyurianto, 2024). Based on the 2018 Riskesdas report, the prevalence of anemia in the 5-14 age group reached 26.8%, while in the 15-24 age group, it was 32%, with the prevalence of anemia in females (27.2%) being higher than in males (20.3%). In 2017, the prevalence of anemia in South Sulawesi was recorded at 13.4%, while data from the South Sulawesi Provincial Health Office indicated that 33.7% of adolescent girls in the region suffered from anemia (Wahyunita et al., 2023; Woisiri et al., 2022). Iron deficiency anemia can be caused by various factors, such as inadequate food

intake, poor dietary habits, low iron availability in foods, and excessive iron loss from the body, especially in women during menstruation (Ministry of Health, 2020). Anemia in adolescent girls negatively affects their health and academic performance and increases the risk of becoming anemic during their reproductive years. This can potentially lead to pregnancies with anemia, protein-energy deficiency, low birth weight (LBW) babies, stunting, as well as complications during pregnancy, childbirth, and even maternal and child mortality (Anggeni & Sundari, 2024).

One way to address anemia in adolescent girls is by consuming iron supplements as part of the government program. However, this approach seems to be not fully effective, so increasing iron intake through the use of local food sources, such as seaweed, is needed (Anggeni & Sundari, 2024). Seaweed is a food commodity rich in compounds essential for hemoglobin synthesis, such as iron, protein, and B vitamins. Additionally, the nutritional content of seaweed, including iron, is approximately 2-10% higher than that of vegetables, due to the presence of phytic acid, which helps stabilize the levels of red blood cells, white blood cells, and hemoglobin (Wahyunita et al., 2023). Seaweed can also reduce the negative impact of inhibited production of cells that form red blood cells. In 2017, Indonesia's seaweed production reached 9,884,669.57 tons, with the highest production coming from South Sulawesi Province at 3,660,973 tons, or 34.71% of the total national production. Palopo City in South Sulawesi is one of the regions with great seaweed potential and has been designated as a key center to support the increase of seaweed production in the province (Bhakti & Patahiruddin, 2021).

Utilizing seaweed as an alternative to address iron deficiency anemia in adolescent girls is highly feasible. However, the habits of adolescent girls, who often spend time outside the home and tend to skip meals while frequently consuming snacks, present a unique challenge. Therefore, processing seaweed into chips can be a solution to ensure that adolescents continue to benefit from seaweed. Nevertheless, the nutritional content of seaweed that has been processed into chips is still not well known (Alfianingsih & Purwito, 2024). The aim of this study is to analyze the nutritional content of seaweed chips as an effort to reduce anemia in adolescent girls.

METHOD

This study uses an experimental design to test the nutritional content of 100 grams of seaweed chips. The analyzed nutrients include macronutrients such as protein and micronutrients like iron, vitamin B9 (folic acid), and vitamin C. The initial steps to obtain valid and objective data involve: (i) sample collection, (ii) laboratory testing using the Kjeldahl method and Atomic Absorption Spectrophotometry (AAS). The Kjeldahl method is used to measure the total protein in all types of food samples, while AAS is employed to analyze the concentration of mineral elements such as iron, calcium, and magnesium.This study was conducted in one of the laboratories in Makassar, with samples collected directly from Dusun Tanete, Poreang Village, North Luwu. The seaweed chip samples consisted of two formula variants: (A) original seaweed chips and (B) spicy seaweed chips. The sample collection and analysis process involved 1 research assistant, 2 field assistants, 1 community leader as the owner of the seaweed chip product, 1 nutrition expert, 3 laboratory technicians, and 1 media representative. Sample selection was carried out using a non-probability technique, specifically purposive sampling, where samples were chosen based on criteria set by the researchers. The sample criteria were seaweed chips from North Luwu with original and spicy flavor variants.

The main ingredients used to make seaweed chips are as follows: approximately 500 grams of fresh seaweed, 1 kilogram of wheat flour (using the Kompas brand), and cooking oil (using the Bimoli or Sofia brand). The processing technique for seaweed as a natural preservative for the product involves soaking for 2 days, steaming, and drying for about 2-3 days (depending on weather conditions). The data analysis of this study focuses on the nutritional content of seaweed chips, particularly the potential iron content that plays a role in preventing anemia in adolescent girls. From the two variants analyzed, both original and spicy seaweed chips, the processing methods, including soaking, steaming, and drying, allow for the preservation of essential minerals, including iron.

RESULT

Table 1.
Nutritional content of seaweed chips

Nutritional Content	Test Results			Average Test Results
	Test I	Test II	Test III	
Original Flavor Chips				
Folic acid (mg/kg)	< 0,25	< 0,25	< 0,25	< 0,25
Vitamin C (%)	49,6	52,12	52.17	51,29
Protein (%)	7,09	7,02	7,18	7,1
Iron (Fe) (µg/g)	38,09	37,69	44,13	39,97
Keripik Rasa Balado				
Folic acid (mg/kg)	< 0,25	< 0,25	< 0,25	< 0,25
Vitamin C (%)	65,68	67,03	68,50	67,1
Protein (%)	7,01	6,76	6,99	6,9
Iron (Fe) (µg/g)	34,62	33,35	31,29	33,1

Based on the research findings regarding the nutritional content of original and spicy-flavored chips, several significant results were obtained. For the original-flavored chips, folic acid measured below 0.25 mg/kg in all tests, indicating a very low content. Vitamin C had an average result of 51.29%, with the highest test reaching 52.17%. The protein content in these chips averaged 7.1%, while iron (Fe) showed an average of 39.97 µg/g. On the other hand, the spicy-flavored chips also demonstrated very low folic acid levels, below 0.25 mg/kg. However, the vitamin C content in these chips was higher, with an average of 67.1% and a maximum value of 68.50%. The protein content of the spicy chips was slightly lower, with an average of 6.9%, and the iron content was recorded at an average of 33.1 µg/g. These findings indicate that although both types of chips have low folic acid levels, the spicy chips excel in vitamin C content, while the original chips have slightly more protein and iron.

DISCUSSION

The results of this study indicate that seaweed chips, both original and spicy-flavored, contain nutrients that can contribute to efforts to reduce anemia in adolescent girls. Anemia is often caused by deficiencies in iron, folic acid, and vitamin C in the daily diet, especially among adolescent girls who are experiencing growth and hormonal changes. In this context, seaweed chips can serve as an alternative snack that provides important nutrients, even though the measured folic acid content in both variants of the chips remains low, at less than 0.25 mg/kg. The high vitamin C content, especially in the spicy-flavored chips with an average of 67.1%, is very significant. Vitamin C plays an essential role in the absorption of iron from food, which can help prevent and address anemia. As stated by Bird et al. (2017), adequate vitamin C intake can enhance the bioavailability of non-heme iron, which is abundant in plant sources. Therefore, even though the iron content in the spicy chips is lower compared to the original chips, the high vitamin C content can support increased iron absorption in the body.

The protein content in both types of chips also shows positive results. The average protein content in the original-flavored chips is 7.1%, while in the spicy chips, it is slightly lower at 6.9%. Protein is an essential nutrient that serves as a structural component in the body and supports growth and development (Shang et al., 2018). In the context of adolescent nutrition, adequate protein intake is crucial for muscle growth and overall health maintenance (Norris et al., 2022). Although these chips cannot be relied upon as a primary source of protein, they can serve as an interesting supplement to the daily diet (Wansink, 2016). Meanwhile, the iron (Fe) content in the original-flavored chips, which averages 39.97 μg/g, is still considered good compared to other food sources. Although the spicy-flavored chips have a lower iron content (average of 33.1 μg/g), their contribution remains significant when viewed in the context of daily consumption. According to Mitchell et al. (2020), replacing less nutritious snacks with iron-rich snacks like these chips can help reduce the risk of anemia, especially in vulnerable groups such as adolescent girls.Although both types of chips have very low folic acid levels, it is important to note that seaweed chips can still be part of a balanced diet. Folic acid is an essential nutrient for cell growth and the prevention of anemia. However, other sources such as green vegetables, legumes, and whole grains should also be emphasized to ensure that these nutritional needs are met (Liew, 2016).

Another advantage of seaweed chips is their low calorie content, which makes them suitable as a healthy snack. The community, especially adolescent girls, often opts for healthier snacks to maintain their weight and overall health (Surgya & Sipahutar, 2022). According to a study by Yesuraj et al. (2022), low-calorie and nutrient-rich snacks can aid in weight management and disease prevention. Seaweed chips provide a healthy and delicious alternative.Based on the results of this study, recommendations can be made to educate adolescent girls about the importance of a balanced nutritional intake and the benefits of seaweed chips as a snack. Although the folic acid content is low, the combination of vitamin C, protein, and iron in these chips can positively contribute to preventing anemia. Therefore, promoting seaweed chips as part of a healthy diet should be considered (Merdeka, 2023). Seaweed chips are a snack with the potential to help reduce anemia in adolescent girls (Pasaribu et al., 2022). Despite the deficiency in folic acid, the high presence of vitamin C and adequate protein makes them a good choice.

CONCLUSION

Seaweed chips, both original and spicy-flavored, have the potential to contribute to efforts to reduce anemia in adolescent girls. Although the folic acid levels in both variants of the chips are measured to be very low, at less than 0.25 mg/kg, the high vitamin C content, especially in the spicy-flavored chips (67.1%), along with adequate protein and iron content, makes these chips a healthy snack alternative. With the presence of vitamin C, iron absorption can be increased, thereby supporting efforts to prevent anemia, which is common among adolescent girls. Further research on processing techniques for seaweed chips that can enhance folic acid and iron levels is necessary to optimize their nutritional quality.

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