ORIGINAL ARTICLE

Effectiveness of giving red spinach leaf capsules to adolescent girls on hemoglobin levels, Kendari City, Indonesia

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ABSTRACT

Approximately 37% of pregnant women and 30% of women aged 15–49 years worldwide are anemic. The aim was to analyze the effect of administering red spinach leaf capsules on increasing hemoglobin levels in adolescent girls. The study was conducted from July to September 2024 at three senior high schools in Kendari City and involved 160 female students in a randomized pretest-posttest controlled design. The study utilized control sheets and questionnaires, an Easy Touch hemometer, and anthropometric measurements. This study used the independent samples T test and paired samples test for statistical analysis. The nutritional composition of the South Sulawesi variety of red spinach leaf capsule extract included protein content of 2.2 mg, iron 91.72 mg, vitamin A 16.3 mg, vitamin C 1125.71 mg, vitamin E 3.3 mg, calcium 2003 mg, vitamin B6 0.512 mg, vitamin B 12 0.10 mg, β-carotene 1.58 mg, and folate 85 mg per 100 grams of material. The level of adequacy of macronutrient and micronutrient intake in respondents was classified as a deficit category because it was <70% of the total nutritional adequacy. The average hemoglobin level in the group administered red spinach leaf capsules before the intervention was 11.07 ± 0.87, which increased to 13.09 ± 0.62 after the intervention. There was a difference in hemoglobin levels before and after the administration of red spinach leaf capsules, with P=0.001. In conclusion, administration of red spinach leaf capsules can increase Hb levels in female students. It is recommended to incorporate red spinach leaf capsules as a dietary supplement for improving hemoglobin levels.

Keywords:
red spinach leaf, capsules, adolescent girl, hemoglobin, anemia

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INTRODUCTION

Anemia in pregnancy is a worldwide public health concern, with the World Health Organization estimating 40% of pregnant individuals globally to be anemic in 2024.[1] Anemia is a serious global public health problem that affects young children, menstruating adolescent girls and women, and pregnant and postpartum women.[2] Compared to 48% in 2000, 40% of children worldwide aged 6–59 months were anaemic in 2019. In non-pregnant women aged 15–49 worldwide, the prevalence of anaemia declined from 31% to 30% between 2000 and 2019, but in pregnant women aged 15–49, it decreased from 41% to 36%, Anaemia was more common than 50% in all women aged 15–49 in 10 countries and more than 70% in children aged 6–59 months in eleven. While the frequency of moderate and severe anaemia decreased in the majority of people and geographic locations, suggesting a shift towards mild anaemia, the incidence of mild anaemia remained relatively constant across all populations, countries, and regions worldwide.[3] The high prevalence of anemia is caused by several factors, including low intake of iron and other nutrients such as vitamins A, C, folate, riboflavin, and B12.[4] To meet daily iron needs, one can consume animal food sources that provide easily absorbed iron and plant food sources that are high sources of iron but difficult to absorb.[5]

Adolescence is a period of physical and mental growth, and development. The need for nutrient-containing food has become quite high.[6] Many young women experience nutritional deficiencies in their daily food consumption. Young women generally experience deficiencies in iron, calcium, and vitamin A.[7] Young women are included in the group prone to anemia because they are in their growth period and experience menstruation every month, which causes iron loss, which is often ignored by teenagers. Most cases of anemia in Indonesia are caused by Fe deficiency.[8] Therefore, iron nutritional anemia is one of the focuses of improving community nutrition, in addition to vitamin A and Iodine Deficiency Disorders.

Nutritional anemia is one of the four nutritional problems in Indonesia, in addition to protein energy deficiency, iodine deficiency disorders, and vitamin A deficiency.[9] In developing countries, such as Indonesia, nutritional anemia is generally caused by a lack of iron, which is required for the formation of red blood cells.[10] Reduced red blood cells result in low hemoglobin levels. Low Hb levels are an indicator of iron deficiency anemia.[11]

Lack of macronutrients, such as carbohydrates, proteins, and fats, and micronutrients, such as vitamins and minerals can have significant health effects.[12] Lack-macro-and micronutrients can cause the body to become thin and lose weight drastically, become short, become sick continuously, and become anemic.[13] Adolescents require iron to form red blood cells. Iron is essential for blood formation during hemoglobin synthesis. This is because adolescents experience menstruation every month, which results in a lack of iron in the blood.[14]

Red spinach leaves contain vitamins A, C, and B, calcium, potassium, iron, and protein, in very high amounts which are easily digested and assimilated by the human body. Red spinach leaves contain various macro- and micronutrients and active ingredients that act as antioxidants.[15] Various types of antioxidant compounds such as ascorbic acid, flavonoids, phenolics, and carotenoids have been identified.[16] Red spinach is used as the main ingredient in hundreds of drugs for both prevention and treatment.

Several studies have examined the benefits of spinach made into juice [17], and extract [18], to increase hemoglobin, but no one has compared its use in capsule form and its effectiveness with commonly

consumed iron tablets. This is the research gap that needs to be filled to gain a deeper understanding of the benefits of using spinach capsules in increasing hemoglobin levels. Thus, this study is expected to provide more comprehensive information on the best way to increase hemoglobin levels through spinach consumption.

The aim of this study was to analyze the effect of administering red spinach leaf capsules on increasing hemoglobin levels in adolescent girls. The novelty of this study lies in the use of red spinach leaves as a natural source of iron that can increase hemoglobin levels. The results of this study are expected to provide new information on effective ways to increase hemoglobin levels in adolescent girls through the consumption of red spinach leaf capsules.

METHODS

Research Design

This is a quasi-experimental quantitative research type. A Randomized pretest-posttest controlled design was used. The division of research subjects into groups was performed randomly using simple random sampling. This study was conducted from July to September 2024 at three senior high schools in Kendari City, Indonesia (Senior High Schools of Soropia, Sampara, and Morosi). This area was chosen because the school area is located on the border, where the lack of access to the city can trigger a lack of nutritional intake for female students. Red spinach and tablets are consumed for 60 days, 2 capsules per day.

Sampling Techniques

This study used all students from three different schools as the sampling frame of this study. The students came from grades 10-12 totaling 18 classes, as a breakdown of Senior High Schools of Soropia (6 classes), Sampara (6 classes), and Morosi (6 classes). The classes were divided into 2 at each level. Researchers used a Simple Random Sampling technique by drawing 160 people, who were divided into control and intervention groups. This method was applied so that each subject who met the criteria had an equal opportunity to be selected as one of the supplementation groups. The sample inclusion criteria were female students who were willing to be respondents in the study and agreed to provide informed consent, aged 15-17 years, female students who were not menstruating, female students who were in good health, or those who did not suffer from serious illnesses. The sample exclusion criteria were female students who were allergic to red spinach, and those who did not consume supplements and blood-boosting herbs.

The samples analyzed were hemoglobin levels from individuals given red spinach leaf capsules and iron tablets, and visits were made both at school and at the respondent's home using the red spinach leaf capsules and the Fe consumption observation sheet. Data collection before and after the administration of red spinach leaf capsules and Fe tablets was carried out by taking as much as 3 cc of blood from the cubital vein of participants for hemoglobin level examination. Blood samples that had been taken were stored in EDTA tubes, and hemoglobin levels were measured using the cyanmet photometer method assisted by the laboratory staff. The anemia was classified based on WHO standards, with categories Normal > 12, Mild=11-11.9, Moderate=8.0-10.9 and Severe=<8.0.

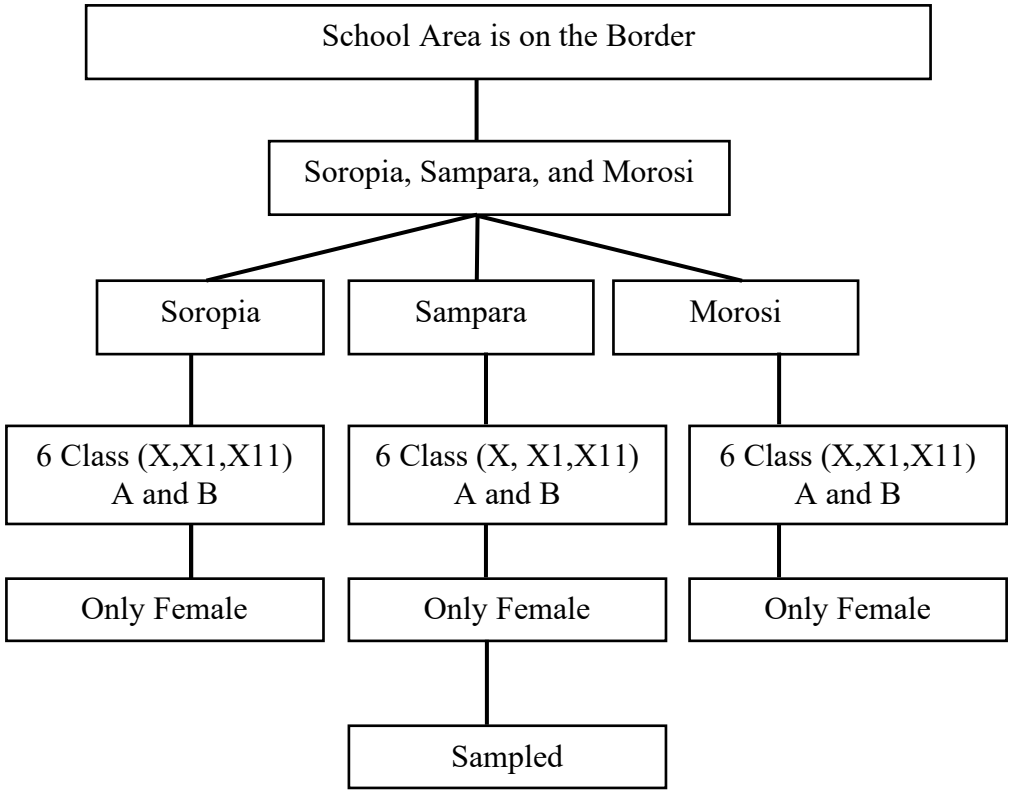

Figure 1. Sampling Frame

Instrument

A control sheet and questionnaire were used to assess the level of compliance with red spinach leaf capsule consumption, food recall, and menstrual cycles in female adolescents. Hemoglobin levels were measured using an easy-to-touch haemometer. Anthropometric measurements were used to determine the body mass index.

Data analysis

Data analysis was performed using Univariate and Bivariate analyses. Univariate analysis was carried out to describe the research variables by creating a frequency distribution table and data distribution in the form of a table. Bivariate analysis was performed on the two variables to determine the existence of a relationship or correlation. In this study, the independent sample T test and paired sample test were used. To facilitate the calculations, we used the computerized SPSS program for Windows version 26.

Ethical Clearance

This study has received ethical approval from Poltekkes Kemenkes Kendari with No.DP.04.03/F.XXXVI.16/001/2024. This study also obtained permission from the respondents through a written consent letter. All data obtained will be kept confidential in accordance with the research ethics standards.

RESULTS

Table 1 shows the nutritional composition of red spinach leaf capsule extract from the South Sulawesi variety, which includes protein content of 2.2 mg, iron 91.72 mg, vitamin A 16.3 mg, vitamin C 1125.71 mg and vitamin E 3.3 mg,

calcium 2003 mg, vitamin B6 0.512 mg, vitamin B 12 0.10 mg, β-carotene 1.58 mg, folate 85 mg per 100 grams of material. Further details can be found in Table 1.

Table 1. Nutritional content of red spinach leaf capsules, South Sulawesi variety

Nutrients	Nutrients per 100 grams of ingredients	Unit
Protein	2.2	mg
Iron	91.72	mg
Vitamin A	16.3	mg
vitamin C	1125.71	mg
vitamin E	3.34	mg
calcium	2003	mg
vitamin B6	0.152	mg
vitamin b12	0.10	mg
β-carotene	1.58	mg
folat	85	µg

Table 2 shows that the samples in the control and intervention groups were homogeneous, indicating that there was no significant difference between the two groups. Therefore, the results of this study were valid and reliable. All results obtained can be relied upon to draw the right conclusions regarding the effectiveness of the intervention.

Table 2. Distribution of respondents based on characteristics

Characteristics	Group				Sample Homogeneity
	Control		Intervention		
	N	%	N	%	
Age (years)					
< 17	80	100	80	100	0.999
≥ 17	0	0	0	0	
Menstrual cycle					
Normal	58	72.5	53	66.25	0.489
Abnormal	22	27.5	27	33.75	
Body Mass Index					
Thin (<18.5)	17	21.25	14	17.5	0.494
Normal (18.5-24.9)	48	60	52	65	
Fat (25.0-29.9)	15	18.75	14	17.5	

Post Hb levels in the group given Fe tablets after the intervention were as follows:19 people (23.75%) with normal Hb status, 43 people (53.75%) experienced mild anemia and 18 people (22.5%) continued to experience moderate anemia, while in the group given red spinach leaf capsules, there were 66 people (82.5%) with normal Hb levels and 14 people (17.5%) experienced moderate anemia. The results of the statistical tests showed a significant difference ($p<0.05$) in Hb levels

between the group administered Fe tablets and the group that received red spinach leaf capsules (p=0.001). Further details can be found in Table 3.

Table 3. Changes in hemoglobin levels of adolescent girls before and after administration of red spinach leaf capsules and iron tablets.

Hb Level Status	Group				P Value
	Fe Tablets		Red Spinach Leaf Capsule		
	N	%	N	%	
Pre					
Normal	13	16.25	17	21.25	
Mild Anemia	45	56.25	49	61.25	0.999
Moderate Anemia	22	27.5	14	17.5	
Post					
Normal	19	23.75	66	82.5	
Mild Anemia	43	53.75	14	17.5	0.001
Moderate Anemia	18	22.5	0	0	

Chi Square

In this study, the eating patterns of adolescent girls were monitored for 60 days in both the intervention and control groups. The level of adequacy of macronutrient and micronutrient intake in the respondents was classified as a deficit category when it was <70% of the total nutritional adequacy. Further details can be found in Table 4.

Table 4. Average distribution of nutrient intake in adolescent girls

Consumption of Nutrients	Mean ± Standard Deviation	Min	Max	nutritional adequacy rate	Adequacy Level
Macronutrients					
Carbohydrate	100.37±10.54	81.5	138.0	292 g	34.38%
Protein	39.86 ± 8.02	27.3	63.3	59 g	67.56%
Fat	33.89 ± 7.79	22.1	46.3	71 g	47.74%
Micronutrients					
Vitamin A	304.59±114.86	187.4	624.0	600.0 μg	50.76%
Vitamin B1	0.65 ± 0.29	0.21	1.79	1.1 mg	59.46%
Vitamin B2	0.63 ±0.28	0.00	1.84	1.3 mg	49%
Vitamin B6	0.62 ± 0.24	0.29	1.64	1.2 mg	69.13%
Vitamin C	39.00 ± 8.79	26.50	78.60	75.0 mg	52%
Vitamin E	5.88 ± 2.40	3.2	17.3	15.0 mg	39.23%
Iron	8.38 ± 3.99	3.6	32.2	26.0 mg	32.23%
Calcium	326.33±153.93	136.3	946.9	4700.0 mg	6.94%

The control group had a lower carbohydrate intake (97.71±10.37) than the intervention group (103.04±10.22), while the intervention group had a higher protein intake (40.95±10.83). The fat intake was significantly higher in the intervention group (37.45±8.06). The average intake of vitamin A was lower in the intervention group (291.70 ± 87.00), while the intake of vitamin B1 (0.70 ± 0.21), vitamin B2 (0.68

± 0.24), vitamin B6 (0.64 ± 0.17), vitamin C (39.28 ± 5.89) was higher in the intervention group. Meanwhile, the intake of vitamin E (5.75 ± 1.63), iron (7.98 ± 1.63), and calcium (315.41 ± 96.36) was lower in the intervention group. No significant differences were found in the nutrient intake levels between the two groups. Further details can be found in Table 5.

Table 5. Average Macronutrient and Micronutrient Intake in Adolescent Girls

Nutrients	Control Group (Mean±standard deviation)	Intervention Group (Mean±standard deviation)	P Value
Macronutrients			
Carbohydrate	97.71 ± 10.37	103.04 ± 10.22	0.086
Protein	38.77 ± 13.93	40.95 ± 10.83	0.507
Fat	35.33 ± 11.03	37.45 ± 8.06	0.050
Micronutrients			
Vitamin A	317.47 ± 1.38	291.70 ± 87.00	0.454
Vitamin B1	0.60 ± 0.33	0.70 ± 0.21	0.216
Vitamin B2	0.59 ± 0.32	0.68 ± 0.24	0.288
Vitamin B6	0.60 ± 0.29	0.64 ± 0.17	0.520
Vitamin C	38.71 ± 1.11	39.28 ± 5.89	0.828
Vitamin E	6.01 ± 3.01	5.75 ± 1.63	0.713
Iron	8.77 ± 5.44	7.98 ± 1.63	0.509
Calcium	337.24 ± 1.97	315.41 ± 96.36	0.637

Independent samples T-test

Table 6 shows the results of the data analysis using the paired samples test to determine whether there is a significant difference between hemoglobin levels before and after administration of red spinach leaf capsules, and to determine the significant difference between hemoglobin levels before and after administration of Fe tablets. Independent samples were tested to determine the significant difference between the intensity of hemoglobin levels in red spinach leaf capsules and Fe tablets.

The average hemoglobin level was 11.05 ± 0.51 in the group given Fe tablets and 11.07 ± 0.87 in the group that received red spinach leaf capsules. The results of statistical tests showed no significant difference ($p>0.05$) between the groups that received Fe tablets and red spinach leaf capsules. This indicates that the hemoglobin levels before the intervention in both groups were the same.

The average hemoglobin level in the group given Fe tablets before the intervention was 11.05 ± 0.51 and after the intervention, it increased to 12.43 ± 0.79. The statistical test results were not significant ($p>0.05$), indicating that there was no difference in hemoglobin levels before and after the administration of Fe tablets. The average hemoglobin level in the group administered red spinach leaf capsules before the intervention was 11.07 ± 0.87, and after the intervention, it increased to 13.09 ± 0.62. The statistical test results were significant ($p<0.05$), which indicated that there was a difference in hemoglobin levels before and after the administration of red spinach leaf capsules. This shows that red spinach leaf capsules can increase hemoglobin levels.

Table 6. Changes in hemoglobin levels in the control group and intervention group

Group	Hemoglobin Level		Difference	P value
	Pre	Post	Mean ± standard deviation	
	Mean ± standard deviation	Mean ± standard deviation		
Control (Fe Tablets)	11.05 ± 0.51	12.43 ± 0.79	1.38 ± 0.28	0.065[b]
Intervention (Red Spinach Leaf Capsule)	11.07 ± 0.87	13.09 ± 0.62	2 ± 0.25	0.001[b]
P value	0.981[a]	0.001[a]	0.001[a]	

(a) Independent samples T test, (b) Paired samples test

DISCUSSION

The study found a significant difference in post-intervention Hb levels between the group that received Fe tablets and the group that received red spinach leaf capsules ($P < 0.001$). The increase in hemoglobin levels in the intervention group was influenced by the macro-and micronutrient components contained in red spinach leaves, such as vitamins A, C, B, K, folate, calcium, potassium, iron, and sodium, in very high amounts that are easily digested and assimilated by the human body. The high iron content in dried red spinach leaves or in the form of red spinach leaf capsules, which is equivalent to 25 times higher than spinach, can be used as an alternative to overcome anemia in adolescent girls.[19] Red spinach leaves are also rich in other essential nutrients such as vitamin C and beta-carotene, which can help improve overall health and immunity. [20]

High iron content in red spinach leaves has been reported to be a nutrient required for hematopoietic processes in the spinal cord.[21] The vitamin C content of red spinach leaves aids in the absorption of iron in the body. Red spinach leaves are rich in antioxidants, which can help reduce inflammation and protect against chronic diseases. The inclusion of red spinach in the diet can contribute to overall health and well-being.[16] Red spinach leaves are a good source of fiber, which can aid digestion and promote gut health. [22]

If anemia occurs, there is an increase in iron absorption due to high needs, so there is an increase after being administered an intervention in the form of a red spinach leaf extract containing iron and vitamin C content that helps in iron absorption.[15] Based on the results of laboratory tests, it is known that the nutritional composition of red spinach leaf extract from the South Sulawesi variety is protein content of 2.2 mg, Iron 91.72 mg, vitamin A 16.3 mg, vitamin C 1125.71 mg and vitamin E 3.3 mg, calcium 2003 mg, vitamin B6 0.512 mg, vitamin B 12 0.10 mg, β-carotene 1.58 mg, folat 85 mg per 100 grams of material. Red spinach leaf capsule supplements are also considered more efficient in preventing anemia and maintaining normal Hb levels.

Red spinach juice demonstrates potential as a safe and effective intervention to improve hemoglobin levels in pregnant women with mild anemia.[23] According to our research, red spinach leaf capsules are effective for the treatment of anemia. Anemia is characterized by low levels of hemoglobin in the blood, leading to symptoms such as fatigue and weakness.[24] Incorporating red spinach leaf capsules into

the diet can provide a natural and potentially beneficial way to combat anemia.[25] Red spinach is rich in iron, which is essential for the production of hemoglobin. [26] This makes it a promising natural remedy for addressing anemia in pregnant women.

Administration of red spinach leaf extract, which has a large nutritional potential, contains various macro and micronutrients, and active ingredients that act as antioxidants.[27] Its many health benefits include its ability to prevent cancer and obesity, shield the body from damage caused by macromolecular oxidation, and prevent age-related macular degeneration.[28,29] Red and green spinach have been found to enhance exercise performance and accelerate recovery in healthy individuals.[30]

The causes of mild anemia in the control group were due to several factors, namely iron loss during menstruation, malnutrition, deficiencies in vitamins, especially vitamin B12 and minerals, and iron deficiency due to a lack of iron in food. This can be caused by an unbalanced diet and a lack of iron intake in daily food. Genetic factors can also play a role in causing mild anemia in the control group. Certain chronic diseases or conditions such as gastrointestinal bleeding or autoimmune disorders can contribute to mild anemia.[31]

Iron is a micronutrient necessary for the body to operate properly. Approximately 60–70% of the 3-5 g Fe present in the adult human body is attached to hemoglobin.[32] Red blood cells, which are required to carry oxygen to the muscles, are produced by the body with the assistance of iron. Athletes and other physically active people may experience exhaustion and lethargy due to their bodies' inability to fulfill the higher demands placed on them by inadequate iron intake.[33]

Giving Fe to adolescent girls at a dose of 2 × 500 mg/day could not increase Hb levels because the nutrient intake of the respondents, especially iron and several vitamins that promote iron absorption, was very low. Macronutrient intake, such as energy and protein intake, is still far from the recommended nutritional adequacy according to the student age group. The nutrient consumption of respondents in the intervention group and the control group showed a sufficient level of carbohydrates 34.38%, protein 67.56%, fat 47.74%, vitamin A 50.76%, vitamin B1 59.46%, vitamin B2 49%, vitamin B6 69.13%, vitamin C 52%, vitamin E 39.23%, iron 24.92% and calcium 6.94%.

Looking at the results of the analysis of the level of nutrient adequacy, the adequacy level was below 70%, meaning that the nutritional adequacy figure is lacking. This is because the food menus consumed were not sufficiently diverse. Respondents rarely ate breakfast. Judging from the food data using the food recall method, respondents only consumed ready-to-eat foods, such as fast food, snacks, and soft drinks. Based on the results of the independent sample test, the P values for carbohydrates were 0.086, 0.507, 0.050, 0.454, vitamin B1 0.216, vitamin B2 0.288, and for vitamin B6 0.520, 0.828, 0.509, and 0.637 (α=0.05). This shows that the diet of adolescent girls had no effect on increasing hemoglobin levels. This can be observed in the nutritional content of adolescent girls.

Hemoglobin, the primary protein of red blood cells, plays a crucial role in oxygen transport and antioxidant protection by binding to glutathione, which affects its oxygen affinity. Hemoglobin is an oxygen-carrying compound found in red blood cells. It is essential for the transportation of oxygen throughout the body to ensure proper functioning of tissues and organs. Low hemoglobin levels can lead to symptoms such as fatigue, weakness, and shortness of breath.[34]

Anemia is a condition in which the blood hemoglobin level is below normal. The need for iron nutrients is three times greater in women than in men. This is because women menstruate every month, which means regular blood loss in large amounts. The factors that cause iron deficiency anemia are nutritional status, influenced by diet, family socioeconomic status, environment, and health status. The factors that cause the high prevalence of iron deficiency anemia in developing countries are low socioeconomic conditions, including limited parental education, low income, and poor personal health.[35] Anemia can be caused by a number of factors, including congenital disorders, chronic inflammation, parasitic infections, and deficiencies in iron, vitamins A and B, and folic acid.[36] However, iron deficiency is thought to be the primary global cause.[37]

The increase in hemoglobin levels in the intervention group was due to red spinach leaves containing high levels of iron. The iron content in red spinach leaves that have been made into capsules is much higher, which is 91.72 mg/100 grams of red spinach leaf capsules. In addition, red spinach leaves contain other essential nutrients. High iron content in red spinach leaves has been reported as a nutrient required for hematopoietic processes in the spinal cord.[38] In addition, protein and amino acid contents are factors that stimulate hematopoiesis.[39] Antioxidants in red spinach leaves can help reduce inflammation and improve overall immune function.[16] Red spinach leaves can increase hemoglobin levels in the blood, both in preclinical and clinical tests. This is because red spinach leaves contain high levels of iron, proteins, and vitamin C. The vitamin C content of red spinach leaves aids in the absorption of iron in the body.[17] Therefore, red spinach leaves can be used as an alternative treatment for anemia in women of reproductive age.

According to previous research, red spinach leaves contain very high amounts of vitamin A, vitamin C, vitamin B, calcium, iron, and protein, which are easily digested and assimilated by the human body. Red spinach leaves have a fairly large potential for nutrients, various macro-and micronutrients, and active ingredients that act as antioxidants.[40] The vitamin C content in red spinach leaf extract facilitates iron absorption.

Red spinach is a good source of natural antioxidants because of the presence of various types of antioxidant compounds, such as ascorbic acid, flavonoids, phenolics, and carotenoids.[41] High concentrations of ascorbic acid, estrogen, β-sitosterol, iron, potassium, phosphorus, copper, and vitamins A, B, and C in red spinach leaves provide many health benefits. The chemical content of amino acids found in red spinach leaves is aspartic acid, glutamic acid, alanine, valine, leucine, isoleucine, histidine, arginine, tryptophan, cysteine, and methionine.[42]

Red spinach contains flavonoids, which function as antioxidants to protect cells from oxidation. Flavonoids are generally found in almost all plants and are bound to sugars as glycosides and aglycones. Flavonoids can function as antimicrobials, antivirals, antioxidants, antihypertensives, and in the treatment of liver dysfunction. Flavonoids are bacteriostatic agents that can inhibit bacterial growth. Flavonoids are phenolic compounds that can be changed by the addition of foaming compounds and ammonia. Flavonoids are water-soluble compounds. The bond of flavonoids with sugars results in many combinations that can occur in plants. Therefore, flavonoids in plants are rarely found in a single state.[43]

Iron deficiency can cause disorders or obstacles to the growth of both body and brain cells.[44] A lack of Hb levels in the blood can cause lethargy, weakness, fatigue, tiredness, and forgetfulness. As a result, learning achievement, sports, and

work productivity may be reduced. In addition, iron deficiency anemia weakens the body's resistance and makes it susceptible to infection.[45]

CONCLUSION

Red spinach leaf capsule extract from the South Sulawesi variety has a fairly high nutritional content, especially in terms of protein and vitamin C. At such nutritional levels, consuming red spinach leaf capsule extract can provide significant health benefits to the body. Administration of red spinach leaf capsules can increase Hb levels in respondents with anemia. In addition, the adequacy of respondents' nutritional intake needs to be considered to prevent nutritional deficits that can cause other health problems. Consumption of red spinach leaf capsule extract can be an effective alternative for increasing Hb levels in individuals with anemia. It is important to pay attention to overall nutritional intake to support overall body health. There was a difference in hemoglobin levels before and after the administration of the red spinach leaf capsules. It can be concluded that the administration of red spinach leaf capsules can increase Hb levels in female students. It is recommended that red spinach leaf capsules be incorporated as a dietary supplement to improve hemoglobin levels in female students with nutritional deficiencies. In addition, regular monitoring of hemoglobin levels and consulting with a healthcare provider is essential to ensure the effectiveness and safety of using red spinach leaf capsules.

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