

Effect of moringa (*Moringa oleifera*) leaves on increasing hemoglobin level of female adolescents in Madrasah Mu'allimat Muhammadiyah Yogyakarta

Fitria Yulastini^{1*}, SN Nurul Makiyah², Retno Mawarti³

¹Qamarul Huda Badaruddin University of Nusa Tenggara Barat, Turmuzi Badrudin, Bagu, Praya, Central Lombok Regency, West Nusa Tenggara, Indonesia

²Muhammadiyah University of Yogyakarta, Jalan Brawijaya, Geblagan, Tamantirto, Kasihan, Bantul, Yogyakarta, Indonesia

³Aisyiyah University of Yogyakarta, Jalan Siliwangi Ringroad Barat No.63, Area Sawah, Nogotirto, Gamping, Sleman, Yogyakarta, Indonesia

*Correspondence : fitriayulastini90@gmail.com

ABSTRAK

Latar Belakang: Anemia defisiensi besi merupakan penyebab anemia yang dominan terjadi di dunia dan menjadi masalah gizi utama di Indonesia yang memiliki prevalensi cukup tinggi pada remaja putri yaitu 22,7%. Daun kelor (*Moringa oleifera*) merupakan salah satu tumbuhan yang kaya protein, asam amino, mineral, dan vitamin. Pemanfaatan daun kelor sebagai pengobatan herbal telah berkembang, salah satunya adalah dapat meningkatkan kadar hemoglobin.

Tujuan: Mengetahui pengaruh pemberian kapsul kelor (*Moringa oleifera*) terhadap kadar hemoglobin pada remaja putri.

Metode: Penelitian ini merupakan penelitian eksperimen murni dengan randomized controlled trial design dan menggunakan simple random sampling. Sampel penelitian adalah 61 remaja putri anemia yang dibagi menjadi 2 kelompok yaitu 31 kelompok perlakuan yang diberikan 500 mg bubuk daun kelor per kapsul dan 30 kelompok kontrol yang diberikan suplementasi zat besi sebesar 60 mg. Intervensi diberikan selama 21 hari dengan dosis 2 kali per hari. Penelitian ini dilaksanakan di salah satu asrama Madrasah Mu'allimat Muhammadiyah Yogyakarta dari bulan September - Oktober 2017. Data berupa kadar hemoglobin dianalisis menggunakan Independent t-test.

Hasil: Kadar hemoglobin pada kelompok perlakuan sebelum intervensi $10,75 \pm 0,94$ gr/dL dan setelah intervensi meningkat menjadi $12,58 \pm 0,99$ (p value 0,000). Kadar hemoglobin pada kelompok kontrol juga meningkat yaitu sebelum intervensi $10,73 \pm 0,89$ dan setelah intervensi $12,13 \pm 0,93$ (p value 0,000). Rata-rata kenaikan kadar hemoglobin pada kelompok perlakuan adalah 1,82 gr/dL dan kelompok kontrol 1,40 gr/dL. Terdapat perbedaan yang signifikan antara kenaikan kadar hemoglobin pada kelompok perlakuan dan kelompok kontrol tersebut dengan p value 0,039 (<0,05).

Kesimpulan: Kadar hemoglobin remaja putri pada kelompok yang diberikan kapsul kelor (*Moringa oleifera*) lebih tinggi dibandingkan dengan kelompok suplementasi zat besi.

KATA KUNCI : daun kelor (*Moringa oleifera*); kadar hemoglobin; remaja putri; tablet Fe

ABSTRACT

Background: Iron deficiency anemia is a dominant cause of anemia in the world, and it is one of the major nutritional problems in Indonesia with high prevalence in female adolescents, which reached 22.7%. Moringa plant (*Moringa oleifera*) contains rich amount of protein, amino acid, mineral, and vitamin. The use of moringa leaves as an herbal treatment has been developed, with one of its main objectives is to increase the hemoglobin level.

Objectives: To analyze the effect of moringa (*Moringa oleifera*) leaves capsule on the hemoglobin level of female adolescents.

Methods: This was a true experimental study with randomized controlled trial design and simple random sampling. Research samples were 61 anemic female adolescents that were classified into two groups. 31 girls were selected as treatment group where they consumed

500 mg of moringa leaves capsules, and the other 30 girls received 60 iron supplements in control group. The intervention was done twice per day for 21 days. This study was conducted in one of the dormitories of Madrasah Mu'allimat Muhammadiyah Yogyakarta from September to October 2017. Data of hemoglobin level was analyzed using independent t-test.

Results: Hemoglobin level in treatment group before the intervention was 10.75 ± 0.94 gr/dL and it increased to 12.58 ± 0.99 (p -value = 0.000) after the intervention. Hemoglobin levels in the control group also increased, namely before the intervention was 10.73 ± 0.89 and after intervention 12.13 ± 0.943 with the p -value of 0.000. The mean hemoglobin level increase in treatment and control groups were 1.82 gr/dL and 1.40 gr/dL, respectively. There was a significant difference between hemoglobin level increase between both groups with the p -value of 0.039 (< 0.05).

Conclusion: The hemoglobin level of female adolescents who consumed moringa (*Moringa oleifera*) leaves capsules was higher than the ones who only took iron supplements.

KEYWORDS: female adolescent; hemoglobin level; iron supplement; moringa leaves (*Moringa oleifera*)

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INTRODUCTION

Iron deficiency anemia is a dominant cause of anemia in the world, and it is one of the four major nutritional problems in Indonesia with high prevalence in adolescents (1,2). Iron deficiency anemia affects more than two billion people around the world. It is not only found in children and women in reproductive age, but also in adolescents, which has a significant effect in the decreased human resource quality (3,4,5). In 2013, Basic Health Research (BHR) reported that anemia prevalence in girls aged 13 – 18 years old and women in a reproductive age of 15 – 49 years old was 22.7% (6).

Various methods have been developed to address iron deficiency anemia, including a screening of anemia in adolescents, supplying iron supplements, conducting the campaign of "Indonesia Anemia Free," and placing treatment of anemia as one of

Sustainable Development Goals (SDGs) program (7,8). The development of science and technology supports many studies of herbs that can be used as medicine, therapy and even prevention of various diseases. Therefore, the utilization of these herbs is increasing. One of the herbs is the moringa plant (*Moringa oleifera*) that can increase the iron level and hemoglobin (9).

Moringa oleifera or moringa plant is a plant that is easy to find in Indonesia and cheap. It contains rich amount of protein, amino acid, mineral, and vitamin. Every 100 gram of moringa leaves contain iron 25 times larger than spinach and vitamin C seven times more than an orange. The high vitamin C content also helps iron absorption; therefore, consuming moringa leaves to treat anemia does not necessarily need the addition of vitamin C as a reducer to help iron absorption (10,11). Moringa leaves also

contains 539 compounds known in Africa and India, and it has been used as a traditional medicine that can prevent more than 300 diseases (12).

Ghebreselassie et al (13) reported that giving moringa leaf extract as much as 600 mg/day for 30 days can increase erythrocytes by around 30%. This is in line with the study of Nadimin *et al* (14) conducted in the coastal area of Makassar, South Sulawesi Province. This study used a Randomized Double Blind design, pretest-posttest controlled by using a sample of non-anemic pregnant women divided into two groups. The first group received the intervention of Moringa leaf extract and the second received supplementation of folic iron. Before and after intervention performed hemoglobin level measurement. Intervention performed during 12 weeks. This study showed an increase in hemoglobin before and after intervention in both groups. This study state that moringa leaves extract can be used as an alternative to prevent anemia during pregnancy. This study aimed to analyze the effect of moringa leaves (*Moringa oleifera*) capsules on hemoglobin level of female adolescents.

MATERIALS AND METHODS

This was a true experimental study with randomized controlled trial design. The studied independent variable was the treatment of moringa leaves (*Moringa oleifera*) capsule, and the dependent variable was hemoglobin level of female adolescents. This study was conducted in one of the dormitories of Madrasah Mu'allimat Muhammadiyah Yogyakarta from September to October 2017. The research samples were

female adolescents in the sixth grade in one of the dormitories of Madrasah Mu'allimat Muhammadiyah Yogyakarta. They were selected randomly based on inclusion and exclusion criteria. Inclusion criteria of this study were female adolescent aged 17-19 years, who had regular menstrual cycles (21-35 days) and mild-moderate anemia (8.3-11.9 gr/dL).

The exclusion criteria in this study were female adolescent who had a history of severe disease affecting hemoglobine levels (kidney failure, lung disease, lymphatic disorders, cancer and malaria) and experienced menstrual disorders including metrorrhagia, hypermenorrhea, polimenorrhea, oligomenorrhea and amenorrhea. Sampling was conducted using simple random sampling to obtain 66 participants that were divided evenly into two groups, treatment and control. Participants in the treatment group received moringa leaves capsule while the ones in control group consumed iron supplement. This study is a single blind, that the research subject do not know which capsules was consumed.

Data were collected using a form of subject characteristic. One week before the intervention, all subjects received antihelminthic (*pyrantel pamoate* 250 mg) capsule to prevent parasite infection. Pre- and post-measurement of hemoglobin level used Sysmex KX-21. Participants in both groups received two capsules per day for 21 days. They received the capsules once in a week. The moringa plant capsule contains 500 mg of moringa leaves powder, and it contains 60 mg of iron. It is the same amount of iron supplement received by participants in

control groups.

Five subjects dropped out in intervention. The total number of subjects at the end of the study was 31 participants in the treatment group and 30 participants in the control group. The data were analyzed using independent t-test with confidence interval (CI) 95%. Ethical clearance was granted by Research Ethics Committee of Universitas 'Aisyiyah Yogyakarta number 19/KEP-UNISA/IX/2017.

RESULTS AND DISCUSSION

Characteristics of the Research Subjects

The characteristics of the subjects in

this study were considered the same because their diet and daily physical activity were controlled by taking subjects who lived in one dormitory, so that an increase in hemoglobin levels was expected from the intervention given. Inhibitors factors (factors that inhibit iron absorption) such as types of food containing tannins (polyphenols), phytic acid, oxalic acid, phosphate and calcium in milk are not allowed to be consumed during the intervention. As can be seen in **Table 1**, the majority of all respondents aged 18 years old, had normal BMI, had mild-moderate anemia.

Table 1. Characteristic of the reserach subjects (n=66)

Variable	Mean	Median	SD	Min	Max
Age	18	18	0.72	17	19
Body Mass Index (BMI)	21.04	20.1	4.45	15.39	35.15
Hemoglobin level pretest	11	11	0.91	8.3	11.9

Table 2. Frequency distribution of moringa leaves intervention and the increase of hemoglobin level of research subjects

Variable	n (%)	Treatment		Control	
		Mean \pm SD	Median (min-max)	Mean \pm SD	Median (min-max)
Treated with moringa					
Yes	31 (50.8)				
No	30 (49.2)				
Hemoglobin level (gr/dl)					
Before intervention		10.75 \pm 0.9	11.1 (8.30-11.90)	10.73 \pm 0.89	11 (8.30-11.90)
After intervention		12.58 \pm 0.99	12.6 (9.60-14.10)	12.13 \pm 0.93	12.2 (10.00-14.10)

Source: developed from primary data, 2017.

Distribution of Subject and Increase in Hemoglobin Level

The total number of subjects at the end of the study was 31 participants in the treatment group and 30 participants in the control group. Data on hemoglobin levels before and after intervention in treatment and control group can be seen in **Table 2**.

Table 2 shows that 31 subjects

(50.8%) received moringa leaves and the other 30 (49.2) did not. The respective mean hemoglobin levels in treatment and control groups before intervention were 10.75 gr/dL and 10.73 gr/dL. Meanwhile, the mean hemoglobin levels in treatment and control groups after intervention were 12.58 gr/dL dan 12.13 gr/dL, respectively.

Table 3. Paired T-test results of hemoglobin level before and after intervention in treatment and control groups

Variable	Hemoglobin Mean±SD	Δ Mean	t-test	p-value
Treatment group				
Before intervention	10.578±0.946	-1.822	-11.078	0
After intervention	12.581±0.996			
Control group				
Before intervention	10.730±0.890	-1.4	-12.565	0
After intervention	12.130±0.934			

Source: developed from primary data, 2017.

The Effect of Moringa (*Moringa oleifera*) Leaves on Increasing Hemoglobin Levels

Analysis of the increase in hemoglobin levels in the treatment group and control group after intervention can be seen **Table 3** and **Table 4**.

The statistic test results in **Table 3** shows that after the intervention, the mean of hemoglobin level in treatment group rose from 10.578±0.946 to 12.581±0.996. Meanwhile, the mean in control group grew from 10.730±0.890 to 12.130±0.934. Both groups had p-value lower than 0.05 (0.000), which means that there was a significant difference between and after intervention in both treatment (moringa leaves) and control groups. This finding is in line with a study conducted by Muis (11). This study used a

Randomized Double Blind design, pretest-posttest controlled by using a sample of pregnant women informal workers and housewives who were divided into three groups. The first group were pregnant women working in the informal sector received the intervention of Moringa leaf extract, the second group were pregnant women working in the informal sector received a placebo as control gorup I and the third group were housewives who did not receive intervention as control group II. This study was conducted for 3 months by looking at changes in hemoglobin levels, upper arm circumference and DNA damage. This study reported that there was a significant difference in work stress level, DNA damage, and hemoglobin level before and after treatment of moringa

leaves extract with p-value lower than 0.001.

After 21 days of intervention, the mean of the hemoglobin level increase in the treatment group (1.8 gr/dL) was higher than the control group (1.4 gr/dL). This could be caused by the apart from a high amount of iron, moringa leaves also have high vitamin C content, which is one of the nutrients that increase iron absorption (15,16). Moringa leaves capsule used in this study contain 130.85 mg iron and 45.82 mg vitamin C per 100 gram. These numbers are higher than the natural iron content in fresh moringa leaves or other green vegetables, such as spinach and *katuk* or star gooseberry (*Sauropus androgynus*) (12). This result is similar with results of Sreelatha & Padma (10) study,

where they reported that 100 gram of moringa leaves contain a high vitamin C content that is seven times more than vitamin C content in an orange. Therefore, consuming moringa leaves capsule does not require an addition of vitamin C supplement as a reducer to help iron absorption.

The absorption of non-heme iron is highly influenced by binding agents that can facilitate or inhibit absorption. It requires substances to maintain iron in a state of dissolution. Moringa leaf is a source of non-heme iron, but it also contains a high amount of protein and amino acid, which improve iron absorption by producing soluble chelate that helps to prevent polymerization and iron precipitation (12,17).

Table 4. Independent T-test results of hemoglobin level difference before and after intervention in treatment and control groups

Variable	Hemoglobin level mean±SD	Δ Mean	t-test	p-value
Treatment group	-1.822±0.916	0.422	2.113	0.039
Control group	-1.400±0.610			

Source: developed from primary data, 2017.

Table 4 shows the difference between the hemoglobin level increase in treatment and control groups had t-value of 2.113 and p-value of 0.039. The results show that the significance level was lower than 0.05, which means that there was a significant difference of hemoglobin level increase between treatment and control groups. Therefore, it can be concluded that consumption of moringa leaves capsule increases the hemoglobin level in female adolescents.

A similar study was conducted by Sindhu *et al* (18) in rural and sub urban Bangalore

over a period of three months from April to June 2012. A simple random sampling of 60 women with moderate anemia suffering was taken where 30 women were treatment group and 30 the control group. Treatment group was given 100 gr/day of *Moringa oleifera* and Jaggery (dry weight) in the ratio 80:20 for thirty days. Control group was advise to continue normal diet. After thirty days the results show that the treatment of moringa leaves powder significantly increased the hemoglobin level of women in reproductive age with anemia. The p-value of the study was

lower than 0.001.

In line with the randomized study was conducted by Idohou *et al* (19) to test efficacy of Moringa powder on iron status and weight gain in lactating women in the Region of Ziguinchor in South Western Senegal from July-October 2001. Data from 64 lactating women received a weekly dose of either (33 people treatment group received 100 mg of Moringa powder and 31 people control group received 120 mg iron sulfat with 0,5 mg folic acid. The results of the study showed that after three months of moringa leaves powder intervention, the average concentration of hemoglobin level improved significantly.

Female adolescents are a group susceptible to iron deficiency because of imbalance between iron intake from foods and increasing iron demand due to their accelerated growth and menstruation. The iron level in the body can be observed by measuring the hemoglobin level. Normal hemoglobin level in female adolescents is 12 g/dL (1,4,20).

The government has provided iron supplement as one method to treat anemia in adolescents. Many studies have reported the effectiveness of the iron supplement. However, it still has several side effects, such as nausea, abdominal bloating and black stools that cause discomfort that ends with disobedience in consuming it (21,22).

Moringa (*Moringa oleifera*) plant contains high nutrients, including antioxidant, macro (protein) and micronutrients, such as vitamin A, vitamin B, vitamin C, calcium, potassium, and iron, which are easily digested and assimilated by the human body. The moringa plant can be used as an alternative for

providing iron supplements for female adolescents, because it is cheap and its leaves can be processed as a vegetable dish to reduce side effects such as nausea and others. Apart from its leaves, other parts of moringa plant also have medicinal properties ranging from roots, stems, seeds, flowers and bark from this plant has been proven to have efficacy for treatment (12,23,24).

Anemia in female adolescent affects their growth, lower learning achievement due to fatigue, loss of fluid, and decreased concentration. Thus, anemic patients should consume 60 – 120 mg of iron per day and increase intake of iron-rich foods. Then, their hemoglobin level is checked after one month of treatment. If the hemoglobin level increases 1-2 g/dL, then the treatment is continued for the next two months, even though the level has increased. The effectiveness of moringa (*Moringa oleifera*) leaves in treating anemia is also reported by Suzana *et al* (25). They conducted a pure experiment study with studied randomized controlled double-blind design to analyze 35 anemic women. The results show that moringa leaves extract could be used as a treatment for iron deficiency anemia with p-value of 0.001.

Apart from anemia treatment, moringa plant can also be used as a supplement for nutritional improvement. This effect was analyzed by a study conducted by Sambou (26) in Tanzania with the treatment of moringa leaves powder on pregnant and lactating women for six weeks. The results show that for pregnant women, the treatment was able to cure anemia and only 10 out of 32 pregnant women gave birth to babies with low birth

weight, including eight mothers who gave birth to twins. Meanwhile, for lactating women, the treatment was able to increase the production of breast milk so that exclusive breastfeeding can be achieved as well as improved maternal health status. The study also states the need for socialization or seminar to introduce the nutrients contained in the moringa leaves (*Moringa oleifera*) that could be used to eradicate malnutrition problems at the family and community level.

CONCLUSION AND RECOMMENDATIONS

Based on the results, it can be concluded that there was a significant difference in hemoglobin level increase between treatment and control groups. This means that hemoglobin level of female adolescent who consumed moringa (*Moringa oleifera*) leaves capsule was higher than the ones who took iron supplement. Therefore, moringa (*Moringa oleifera*) leaves capsule can be used as an alternative to increase hemoglobin level and prevent iron deficiency anemia.

We expect the results of this study provide information for the need of socialization of nutrients contained in moringa leaves and their benefits particularly in treating and preventing iron deficiency anemia for female adolescents. Moreover, the results can also be used as a reference for future studies by adding variables related to micronutrients from plants, which can be used to increase the hemoglobin level.

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