

RESEARCH ARTICLE

The Effect of Moringa Leaf *Cilok* Supply on Hemoglobin Levels of Female Adolescents with Anemia

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Abstract

Blood that contains less iron can cause anemia. This nutritional case is the most common in almost all countries, including Indonesia. Female adolescents are more at risk of anemia due to stress, eating late, and losing large amounts of iron during menstruation. One part of the moringa plant (*Moringa oleifera*), namely the leaves, is believed to increase hemoglobin levels. The method of attracting adolescents to moringa leaf is by processing the moringa leaf becomes a snack called moringa leaf *cilok*. This research aims to determine the hemoglobin level of adolescent girls who experience anemia before and after being given moringa leaves *cilok*. This is experimental research with one group pre-post test design from October to November 2021 in Mataram. The subjects in this research are female adolescents with anemia who met the sample criteria. The sample used is $n_1=n_2=32$ respondents. The treatment group received moringa leaf *cilok* and was controlled tablets by giving iron tablets. The data collected was processed by a nonparametric test. The results show an effect of giving moringa leaf *cilok* on the hemoglobin levels of adolescent girls ($p>0.05$). The content of iron and vitamin C in moringa leaves *cilok* has increased hemoglobin levels. This research concludes that moringa leaf *cilok* can increase hemoglobin levels in female adolescents. Therefore, consuming moringa leaves *cilok* regularly can be used to treat anemia.

Keywords: *Cilok*, hemoglobin level, moringa leaf

Introduction

Blood that contains less iron can cause anemia. This nutritional case is the most common in almost all countries globally, including Indonesia.¹ Every age group has the potential to experience anemia, including adolescents, where the World Health Organization (WHO) defines adolescents as children aged 10–20 years.¹ According to WHO, around 29.9% of women of reproductive age have anemia in 2019.² According to the Basic Health Research (*Riskesdas*), anemia in female adolescents has increased from 37.1% in 2013 to 48.9% in 2018.³

The leading cause of anemia is the lack of iron intake.⁴ Female adolescents are more at risk for anemia due to losing significant amounts of iron during menstruation.⁵ Female adolescents who experience anemia are more at risk for morbidity and mortality during their reproduction period.⁶

Iron intake can be obtained by consuming food from animal proteins such as liver, fish, and meat. However, not all people can eat this food, so they have to take blood-boosting tablets.⁷

Governments' effort to decrease the anemia rate in female adolescents is by giving a blood-

boosting tablet per week through the School Health Promotion or *Usaha Kesehatan Sekolah/ Madrasah* (UKS/M) in educational institutions throughout the year. The coverage of blood-boosting tablet consumption in the province of West Nusa Tenggara has reached 38.22%. According to the 2017 Indonesia Demographic and Health Survey: Adolescents, 57.0% of female adolescents overcome anemia by taking pills to increase their blood, and 14.0% take iron tablets.⁸ Whereas only 19.8% consume meat, fish, and liver, 31.8% consume vegetables that contain iron, 2.8% others, and 8.8% are clueless.⁸

Moringa leaves have very high amounts of vitamin A, vitamin C, vitamin B, calcium, potassium, iron, and protein which are easily digested and assimilated by the human body.^{9–11}

Moringa leaves are vegetables that have been used to treat malnutrition in children, adolescents, and pregnant women.¹¹ In addition, the micronutrients such as iron can be used as an alternative supplement for female adolescents to prevent anemia. Moringa leaves effectively increase hemoglobin (Hb) levels in children and women with anemia. The iron in moringa leaves processed into powder (flour) is higher than in

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fresh moringa leaves.¹² Arini's¹³ research results show Hb levels in female adolescents experienced a change between before being given moringa leaf flour Hb levels of 10.88 mg/dL and after being given moringa leaf flour Hb levels to 12.27 mg/dL.

The results of non-clinical tests showed that administration of moringa leaf extract at a dose of 400 mg/kgBW affected increasing Hb levels in Wistar strain rats. The rats were previously induced by aluminum chloride for 21 days, resulting in mild anemia with a Hb level of 10.80 g/dL.¹⁴

The clinical trials showed that giving moringa leaf extract at a dose of 2×1 with a content of 1,000 mg in female adolescents increased Hb levels after two months of intervention.¹⁵ Another study also showed that giving 2×2 doses of moringa leaf flour capsules containing 500 mg of flour per capsule in the morning and evening for 12 weeks was able to increase the Hb levels of female adolescents.¹³ Changes in Hb levels in the control group of 14 people (58.3%) with an increase in Hb levels of 0.3–3.5 g/dL who were not given moringa leaf flour, while in the intervention group, the changes in Hb levels were 22 people (91.7%) with an increase in Hb levels of 1.5–2.2 g/dL after being given moringa leaf flour.¹³ The rise in Hb levels is due to the iron in moringa leaves, it is rich in vitamin C that helps the absorption of iron.¹⁶

Cilok—an Indonesian ball-shaped dumpling made from *aci* (tapioca starch), a Sundanese snack originating from West Java, Indonesia—is one of the favorite snacks among adolescents. The results of Bonita and Fitrianti's¹⁷ research show that adolescents are into fast food. One of them is *cilok*, with 17.4% of adolescents consuming *cilok* more or twice a week. Utilization of local resources such as moringa leaves and increasing the nutritional value of *cilok*, the substitution of moringa leaf flour in the manufacture of *cilok* is carried out so that the produced *cilok* can be claimed as a *cilok* source of iron.¹⁷ This research aims to identify the effect of moringa leaf *cilok* (*Moringa oleifera*) supply on hemoglobin levels of female adolescents with anemia.

Methods

The research consists of two stages, those are making moringa leaf *cilok* and product testing.

Moringa leaf *cilok* is made using 4 grams

of moringa leaf flour, 50 grams of flour, 50 grams of tapioca flour, 2 grams of salt, 70 mL of water, 2 grams of mushroom broth, and one stalk of leek, and cooked until done. The produced *cilok* of moringa leaf is then checked for iron and vitamin C compounds. The study is carried out at the Pharmacy Laboratory of the Universitas Muhammadiyah Mataram.

The method is experimental research with one group pre-post test design. The hemoglobin level was checked before the research subjects were given moringa leaf *cilok* in the treatment group and blood-boosting tablets in the control group. After that, the control group was assigned treatment with iron tablets and blood-enhancing substances for 15 days, and the Hb was rechecked on the 16th day. The sample in this research was female adolescents who experienced mild anemia with the Hb number range 9–11 g/dL from October to November 2021 at STIKes Yarsi Mataram.

There were two groups of respondents in this research. The treatment group received moringa leaf *cilok* twice a day with a mixture of 4 grams of moringa leaf flour in the dough for making *cilok* in each supply, and the control group was given one caplet iron twice a day for 15 days. The evaluation was carried out on the 16th day by checking Hb levels using the Easy Touch brand Hb set. Three enumerators from the Midwifery Study Program students at STIKes Yarsi Mataram assisted this research and distributed moringa leaf *cilok* and iron tablets to respondents.

Data processing is conducted before testing the data obtained by the Kolmogorov-Smirnov normality test with $p=0.05$. In analyzing the effect of moringa leaf *cilok* supply on female adolescents' Hb levels, the Wilcoxon test is used if the data is not normally distributed.

This research has received research ethics from the Research Ethics Committee of the Faculty of Medicine, Universitas Islam Al-Azhar Mataram, with the number: 40/EC-04/FK-06/UNIZAR/X/2021.

Results

Research results on the identification of Fe content in moringa leaf *cilok* as efforts to increase the Hb of female adolescents can be seen in Table 1 and Table 2.

Based on Table 3, it shows that there is an effect of giving moringa leaf *cilok* on the Hb levels

Table 1 Result of Laboratory Testing Fe Content in Moringa Leaf *Cilok*

Ingredients	Metal	Reactor	Observation	Result
Cilok	Fe	KSCN	Formation of a blood red solution	+
Moringa powder	Fe	KSCN	Formation of a blood red solution	+

Table 2 Result of Laboratory Testing Vitamin C Content in Moringa Leaf *Cilok*

Ingredients	Pre-color	Post-color	Number of Drops	Result
Cilok	Redish brown	Bluish black	160	+
Moringa powder	Redish brown	Yellow	210	+
Vitamin C	Redish brown	Orange	15	+

Table 3 Effect of Moringa Leaves *Cilok* on Hemoglobin Levels for Adolescent Girls

Groups	Median (Min–Max)	p
Experimental Hemoglobin		0.000
Before treatment	11.5 (10.1–11.8)	
After treatment	12.5 (12.1–13.0)	
Control Hemoglobin		0.001
Before treatment	11.0 (10–11.9)	
After treatment	13.6 (11–17.0)	

of female adolescents.

Discussion

Compared to spinach, the iron content in dried moringa leaves or flour is 25 times higher, so moringa leaves can be used as an option to overcome anemia.¹⁸ Moringa leaves have great potential to fulfill nutritional needs. Anemia is a condition in which the Hb level is lower than the standard limit. Normal Hb levels in female adolescents are >12 g/dL.^{19,20} Thus, teenage girls are considered anemic if the Hb level is <12 g/dL. The causes of anemia include lack of nutritional deficiency due to low intake of both animal and vegetable nutrients, which are sources of iron that play an important role in forming hemoglobin. The cause was also bleeding due to prolonged and large amounts of menstruation and bleeding due to infectious diseases such as malaria and

dengue fever. Another factor that causes anemia is an unhealthy, irregular, and unbalanced diet supported by adequate nutritional sources needed by the body, such as energy, protein, carbohydrates, fat, and vitamin C intake. It is primarily the intake of adequate food sources containing iron and folic acid.²¹ Iron deficiency anemia can be caused by several factors, one of which is consuming less animal food sources as a source of easily absorbed iron (heme iron). Meanwhile, plant food sources (non-heme iron) are sources of high iron that are difficult to absorb. Anemia can also be affected due to a lack of nutrients that play a role in facilitating the absorption of iron, such as protein and vitamin C.²²

Anemia in adolescent girls can be treated by using leaves from local plants that grow around them, which contain iron and various vitamins, such as moringa leaves to boost the function of Hb.²³ The vital role of hemoglobin in blood cells is to bind and carry oxygen in red blood cells. Suppose the supply of oxygen in various places throughout the body is achieved. In that case, the benefits obtained are that it can reduce the occurrence of dysmenorrhea due to ischemia in adolescent girls.²⁴

This study gave moringa leaf *cilok* to adolescent girls with anemia for 15 days. The results show that consuming moringa leaf *cilok* regularly can increase hemoglobin levels in teenage girls tested on day 16. Another study also showed that giving 2×2 doses of moringa leaf flour capsules containing 500 mg of flour per capsule in the morning and evening for 12 weeks was able to increase the Hb levels of female adolescents.¹³ Changes in Hb levels in the control group of 14

people (58.3%) with an increase in Hb levels of 0.3–3.5 g/dL who were not given moringa leaf flour, while in the intervention group, the changes in Hb levels were 22 people (91.7%) with an increase in Hb levels of 1.5–2.2 g/dL after being given moringa leaf flour. The rise in Hb levels is due to the iron in moringa leaves, which is rich in vitamin C that helps the absorption of iron.¹⁶

Moringa (*Moringa oleifera*) is one of the local plants which has long been known as a plant that has many benefits plant which is rich in nutrients and has medicinal properties. It contains natural compounds that are higher and more varied than other types of plants. The research finds that moringa leaves contain very high amounts of vitamin A, vitamin B, vitamin C, calcium, potassium, iron, and protein, easily digested by the human body.²⁵

Moringa leaf extract consumed regularly can help increase hemoglobin levels in the blood.²⁴ Teenage girls who are affected by anemia should consume moringa leaf extract.¹⁸ A study conducted in the Pharmacy Laboratory at the University of Mataram reveals that moringa leaves contain vitamin C and iron.

Several studies also state that the human body quickly digests moringa leaves with several nutritional contents such as iron, protein, vitamin A, vitamin C, potassium, calcium, and antioxidants. Compared to other vegetables, moringa leaves have a high iron content, 26 mg/100 g. Iron (Fe) in dry moringa leaves or moringa leaf flour is equivalent to 25 times higher than spinach.^{16,26}

The complete nutritional content of moringa leaves consists of various types of micro and macronutrients and antioxidant compounds. In addition, it also contains essential nutrients such as Fe, protein, and calcium. A relatively complete variety of vitamins such as vitamin A, vitamin C, vitamin D, vitamin E, and vitamin B complexes (B1, B2, B5, B3, B6, B9, and B12). The content of vitamin C in moringa leaf extract helps the absorption of iron in the body.²⁶ Moringa leaves are widely used for prevention and treatment, so they are widely used as the primary medicine component.²⁷

Moringa leaves can be used as a medicine for anemia in low or high doses. The number of red blood cells (erythrocytes) and white blood cells (leukocytes) that significantly increases proves that moringa leaves are good for use as food supplements and drugs for anemia sufferers.²⁸

Conclusions

There is an effect of giving moringa leaf *cilok* and blood-added tablets on hemoglobin levels.

Conflict of Interest

There is no conflict of interest in this research.

Acknowledgment

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