

The Miracle of Moringa Oleifera Leaves for the Prevention of Anemia: A Literature Review

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ABSTRACT

Background: *Moringa oleifera* leaves contain very rich compounds that include nutrients, minerals, vitamins, amino acids, and many other compounds with numerous benefits for humans. This literature review discusses the benefits of *Moringa oleifera* leaves in preventing anemia. **Methods:** This review is a narrative review using the research of international journal sources from databased, national journals in the last ten years. The keywords anemia, hemoglobin, and *Moringa oleifera*/*M. oleifera* leaves were used. Based on the 35 journals reviewed, 12 studies were included in this review. **Results:** The literature results show a positive relationship between Moringa leaf extract and an increase in the value of hemoglobin levels, with a p-value <0.05. However, this review found other benefits of *Moringa oleifera* leaf extract, such as improving the morphology of damaged red blood cells and antioxidants. It has become an alternative in the treatment of anemia. **Conclusions:** The nutrient content in Moringa leaf extract plays a significant part in increasing hemoglobin levels in the blood. Other factors that can increase the risk of anemia are micronutrient deficiency, infectious diseases (HIV/AIDS, tuberculosis, and malaria), worm infections, and genetic disorders. (25) We recommend conducting an experimental study to compare two groups given Moringa leaf extract and multi-micronutrient tablets to get more effective results in lowering the prevalence of anemia.

Key words: *Moringa oleifera* leaf extract, Anemia.

INTRODUCTION

Anemia is a public health problem in developing and developed countries, with different consequences for the health and socio-economic development sectors.¹ Anemia is a nutritional problem and occurs when the hemoglobin in the blood is below normal limits, so the blood's ability to carry oxygen throughout the body will be disrupted.¹⁻³ The world health organization (WHO) estimates that more than 2 billion people, or one-quarter of the world's population, suffer from anemia.² Non-communicable diseases in Indonesia that are still common include anemia. In 2018, children and women of childbearing age (WCBA) were the most at-risk group, with an estimated prevalence of anemia in WCBA in Indonesia at 35.3%. Anemia in children under five was 47%, pregnant women 42%, and not pregnant women aged 15–49 was 30%.⁴

In general, anemia is caused by iron deficiency due to an iron imbalance over a long time or an absorption disorder. Other factors that can cause iron deficiency are increased iron requirements during pregnancy or growth, menstruation, infectious diseases, nutritional deficiencies (folate, vitamins B12, A, and C), and genetic disorders (sickle cell disease, thalassemia/blood disorders resulting from chronic infections).⁵ Although various factors cause anemia, more than 50% of cases worldwide are caused by a lack of iron intake.

Anemia can occur due to an increase in body requirements caused by chronic diseases, a loss of blood in women due to menstruation, and the occurrence of parasitic infections (worms). Experimental research studies show that iron

deficiency can cause cognitive impairment in animals and humans, impacting mitochondrial damage in the brain. Cognitive impairment due to iron deficiency results in impaired interest, intelligence, and sensory perception functions related to feelings and behavior.⁵ Generally, this disorder has been associated with anemic iron deficiency.⁵ In addition, the incidence of anemia in WCBA will affect reproductive health, namely, giving birth to babies with low birth weight (LBW) and other complications during pregnancy.

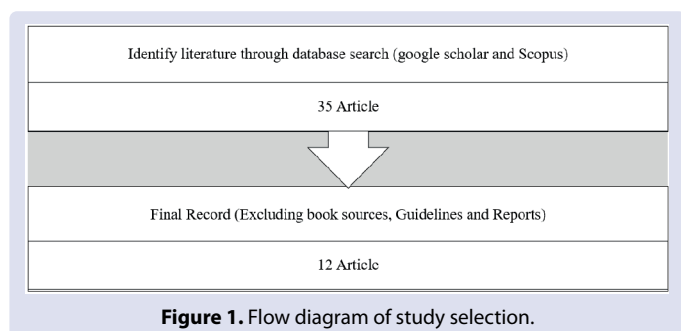
Currently, worldwide and in Indonesia, anemia is still a nutritional problem. However, the government has made efforts to overcome anemia by implementing national programs and strategies, such as providing iron (Fe) tablet supplementation for pregnant women, women of childbearing age, and adolescent girls.⁸ However, Fe tablets alone are not enough for preventing anemia. This is due to the influence of other factors that can increase the risk of anemia, such as micronutrient deficiency, infectious diseases (HIV/AIDS, tuberculosis, and malaria), worm infections, and genetic disorders.²⁵ In addition, an effect of Fe tablets that often appears is nausea, resulting in a decrease in interest in consuming these tablets.⁴

Good nutritional intake during pregnancy is important, namely, by consuming many macronutrients and micronutrients that meet additional nutritional needs during pregnancy. The mother's nutritional status is influenced by the amount of energy or calorie intake, protein, carbohydrates, iron, folic acid, vitamin A, zinc, iodine, calcium, and other nutrients. Moringa leaf (*Moringa*

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Table 1. Research results related to the effect of the intervention of giving Moringa leaf extract on the incidence of anemia.

No	Study	Intervention	Research result
1.	Fauziandari (2011) ⁸	Moringa leaf extract (<i>M. oleifera</i> leaves)	From the analysis results in this study, it was found that the average Hb level after consuming Moringa leaf extract was higher than it was before consuming Moringa leaf extract. The correlation value between the two variables is 0.419, which means that the relationship between the two variables is strong and positive. The results of sig (2-tailed) are that the p-value is 0.009; it can be concluded that if the p-value is <0.05, then there is an increase in Hb levels before and after administration of Moringa leaf extract.
2.	Triananinsi (2019) ⁹	Moringa leaf capsules and Fe tablets	From the analysis results with the Wilcoxon test, there was a significant relationship between before and after taking Fe tablets and Moringa leaf capsules on Hb levels in mothers, which was indicated by a p-value of 0.000, which was less than 0.05.
3.	Tinna (2018) ¹⁰	Moringa leaf flour with Fe tablets	From the analysis results, the administration of Fe together with the provision of Moringa flour in the intervention group effectively increased erythrocyte levels (p: 0.033) compared to the control group, which was only given Fe tablets (p: 0.107).
4.	Hikma et al. (2021) ¹¹	Iron tablets and Moringa leaf tea	The results of this study indicate an effect of giving iron tablets and Moringa leaf tea to increase hemoglobin levels of pregnant women, where the average hepcidin level is 0.560 ± 1.10 so that consumption of iron tablets and Moringa leaf tea is better in increasing hemoglobin levels.
5.	Sindhu S. et al. (2013) ¹²	<i>Moringa oleifera</i> and jaggery (dry weight)	The outcomes were analyzed based on percentage and proportions. The student's t-test found a great difference between the intervention and control groups. At the end of the supplementation duration (30 days), the women within the intervention group showed growth in hemoglobin levels. The results of this study using a t-test indicate that the administration of <i>Moringa oleifera</i> and jaggery could be significant in increasing the hemoglobin level of anemic women, with a p-value <0.001.
6.	Osman et al. (2012) ¹³	<i>M. oleifera</i> extract and normal saline solution	It was found that AICI3 could significantly reduce RBCs, MCHC, hemoglobin, PCV, iron levels, and MCV, with the p-value p<0.05. No significant change was found in the decrease in white blood cells (WBC), lymphocytes (LYM) (p<0.05), and platelets (PLT). This study also found that the ethanolic extract of <i>M. oleifera</i> given with AICI3 could significantly increase RBCs, Hb, MCHC, and PCV compared with the placebo group only given AICI3. Other results found that administration of only <i>M. oleifera</i> extract could cause significant growth in RBCs, MCHC, and Hb blood cells, which were characterized by a p-value <0.01 when compared to the control group. However, the results revealed the ethanolic extract of <i>M. oleifera</i> , either supplied with AICI3 or only an extract of <i>M. oleifera</i> .
7.	Mun'im et al. (2016) ¹⁴	Ferrous fumarate and Moringa leaf extract	This study shows that Moringa leaf extract can increase hemoglobin, red blood cells, hematocrit, and total iron content in the blood. In addition, Moringa leaf extract at a dose of 792 mg/200g BW can significantly increase the morphology of red blood cells, as indicated by the p-value p<0.05.
8.	Hermayanti et al. ¹⁵	Moringa leaf extract and vitamin C	The results using a one-way ANOVA test revealed hemoglobin with a p-value of 0.000, MCV 0.27, KIA 0.16, serum ferritin 0.000, transferrin saturation 0.006, and TIBC 0.68. The analysis using the Pearson hemoglobin correlation test showed a p-value of 0.746. A linear regression test showed an R2 of 0.557 with a p-value of 0.000. Serum ferritin was 0.742 with a p-value of 0.000 with an R2 of 0.551 and a p-value of 0.000. From the outcome of this study, it can be concluded that there was an increase in hemoglobin and serum ferritin in the intervention group.
9.	Iskandar et al. (2015) ¹⁶	<i>M. oleifera</i> extract	This study found an increase of hemoglobin levels in the intervention group, with a p-value <0.05 when consuming <i>Moringa oleifera</i> leaf extract. It increased hemoglobin to 58% compared to the control group, where mothers in the control group did not experience a significant change in hemoglobin. This study also found that <i>Moringa oleifera</i> extract can maintain a serum ferritin range of up to 50%. There were no cases of LBW in mothers who consumed Moringa leaf extract. In addition, this research provides information about the dosage for consuming Moringa leaf extract.
10.	Nadimin et al. (2015) ¹⁷	<i>M. oleifera</i> extract	In this study, several results were obtained. The mothers who were given Moringa leaf extract experienced a change in Hb news, where the Hb level before the intervention (11.283 ± 0.777 g/dL) changed after the intervention (1.754 ± 1.089 g/dL), with a p-value of 0.040.
11.	Hastuty et al. (2020) ¹⁸	Moringa leaf extract plus royal jelly and placebo	In the iron group, there was also an increase in the Hb of pregnant women before and after the intervention, with a p-value of 0.002. In addition, this study also found that the quantity of Hb growth in the iron group (0.9886 ± 1.7638 g/dL) was higher than that in the Moringa leaf extract group (0.4771 ± 1.3051 g/dL), but the increased Hb levels in both groups were considered quite large but not significant, with a p-value of 0.168.
12.	Tirtawati et al. (2021) ¹⁹	Teabags <i>M. oleifera</i>	In a study based on the characteristics of subjects according to age, education, career, income, and parity, it was found that there was an increase in erythrocyte index levels in the three examiner groups. The MLERJ group showed significant changes in MCV, MCH, and MCHC, and the MLE group showed significant changes. The significant erythrocyte indices were MCV and MCHC, while in the control group, only one index showed significant changes, namely, MCV.
			This study showed a significant difference in hemoglobin before and after the intervention with a p-value of 0.000. On the 15th day of the intervention, there was a change in the average of Hb (11.03 g/dl). Then, on the 30th day of the intervention, it showed an increase in the average hemoglobin change to 11.63 g/dl.



oleifera)¹ is a food component that is wealthy in micronutrients and considered highly available, but it is no longer used optimally. This type of food is easily found in tropical and subtropical countries and has traditionally been used by the community empirically for a long time.⁶

Moringa leaves are known as plants with many benefits, and even WHO has made Moringa an alternative food for overcoming nutritional problems (malnutrition). WHO also recommends that pregnant women, infants, and children in their infancy consume Moringa leaves because they are rich in nutrients.⁷ Moringa leaves contain iron, protein, vitamin A, vitamin C, potassium, and calcium. Moringa leaves are an alternative for overcoming anemia because they contain 28.2 mg of iron.⁷ In addition, Moringa leaves also contain B vitamins, are high in protein, and are easy to digest and assimilate by the human body, so the macro and micronutrients contained in Moringa leaves can prevent anemia. Based on the background above, this article aims to review the benefits of *Moringa oleifera* in increasing hemoglobin levels and anemia prevention efforts.

METHODS

The keywords such as anaemia, haemoglobin, and *moringa oleifera/m.oleifera leaves* were used. This literature review did not limit the type or design of the study.

RESULTS

Table 1 shows the results of relevant studies related to giving Moringa leaf extract on the incidence of anemia. Of the 12 studies, four used only Moringa leaf extract (*M. oleifera*), four added Fe tablets, and another added palm sugar, salt solution, royal jelly, and vitamin C. In addition, there were three types of extracts. Moringa leaves in this study were Moringa leaf flour, Moringa leaf tea, and Moringa leaf capsules.

DISCUSSION

Moringa oleifera Leaf Extract Against Anemia

Literature studies that have been carried out show an increase in hemoglobin levels in adolescents after being given Moringa leaf extract. So, it can be concluded that in addition to consuming iron-folic acid tablets, the consumption of Moringa leaf extract can be an alternative for overcoming the problem of anemia.⁸ A research showed that the average Hb level after consuming Moringa leaf extract was higher than it was before consuming Moringa leaf extract. The correlation value between the two variables is 0.419, which means that the relationship between the two variables is strong and positive. Sig (2-tailed) results show the p-value $0.009 < 0.05$, so it can be concluded that there was an increase in Hb levels before and after administration of Moringa leaf extract.⁸ So, from the study results, it can be concluded that Moringa leaves can be an alternative source of iron. Meanwhile, other studies that used the Wilcoxon test to analyze found a significant relationship between before and after consuming Fe tablets and moringa leaf capsules against the Hb levels of pregnant women. Moringa leaf

capsules contain iron, and vitamin C and other vitamins can help iron absorption.⁹

Moringa oleifera Leaf Extract Plus Royal Jelly and Vitamin C Against Anemia

The study results from several sources found that the Moringa leaf supplement and royal jelly increased MCV, MCH, and MCH erythrocyte index levels, with a statistically significant effect on increasing erythrocyte index levels in pregnant women with anemia, with $p = 0.000 < 0.05$. The highest increase in erythrocyte index levels was found in the intervention group of Moringa leaf extract added with royal jelly supplementation. This finding is supported by research conducted by Adegbite et al., (2016) which showed that after administration of Moringa leaf flour, there was a significant increase in the value of MCV levels.²² Research conducted by Suzana et al. (2017) on the administration of Moringa leaf extract capsules at a dose of 700 mg/capsule showed that it could affect MCV levels.²³ There is an increase in the erythrocyte index level because *Moringa oleifera* contains alkaloids, phytosterols, saponins, and flavonoids, which are known to have hematopoietic properties. In addition, there are also vitamins A, B, and C and minerals such as iron. One of the functions of iron is to form erythrocytes, especially the formation of hemoglobin in the blood. Research related to the erythrocyte index conducted by Sri Muliani et al. (2019) in adolescent girls with anemia showed that supplementation of Moringa leaf flour and bee bread could increase the levels of the erythrocyte index, namely, MCV, MCH, and MCHC.¹⁸

The nutritional content of honey is almost the same as royal jelly, which contains iron (Fe), a very important micro-mineral in the body because it can function as a red blood cell builder. The iron content can synthesize the formation of heme, which can stimulate hemoglobin levels. In addition to low iron intake, anemia is caused by low nutrients that act as absorbents (boosters). Vitamin C is an important enhancing compound to increase iron absorption. The presence of vitamin C in the food consumed by pregnant women will improve the process of iron absorption.²⁴ The vitamin C in Moringa leaf extract and royal jelly plays an important role in absorbing iron in the body. If Moringa leaf flour is combined with royal jelly, the iron absorption process will be faster, which will impact increasing hemoglobin and erythrocyte index levels.¹⁸

CONCLUSION

The nutrient content in Moringa leaf extract plays an important part in the hemoglobin levels in the blood. Other factors that can increase the risk of anemia are micronutrient deficiency, infectious diseases (HIV/AIDS, tuberculosis, and malaria), worm infections, and genetic disorders.²⁵ We recommend conducting an experimental study to compare two groups given Moringa leaf extract and multi-micronutrient tablets to get more effective results in lowering the prevalence of anemia.

CONFLICTS OF INTEREST

The authors declare that they have no conflict of interest.

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