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Mini Review

A review on intake of *Moringa oleifera* leaf in different forms to increase hemoglobin levels in females

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ABSTRACT

Hemoglobin (Hb) is a protein contained in red blood cells responsible for delivery of oxygen to the tissues. To ensure adequate tissue oxygenation, a sufficient hemoglobin level must be maintained. The amount of hemoglobin in whole blood is expressed in grams per deciliter (g/dl). The average Hb level for males is 14 to 18 g/dl while females are 12 to 16 g/dl. When the hemoglobin level is low, the patient has anemia. In case of female, anemia is very common phenomenon. Anemia is generally caused by iron deficiency. Efforts that can be made to overcome the lack of iron intake in females are to consume iron (Fe) tablets. The consumption of iron (Fe) tablets is not the only source of iron. Foods such as Moringa leave also contain iron. The objective of this literature review is to explore the impact of the intake of various forms of *Moringa oleifera* leaves on hemoglobin levels in females at different stages. The method used in writing this article is review of research result related to intake *Moringa oleifera* leaves at different form to increase hemoglobin levels in females. Based on the articles that have been analyzed it can be seen that, administration of the *Moringa oleifera* leaves juice among anemic female had a significant increase in hemoglobin level and the powder form capsules intake by postpartum mother, indicates greater increase in hemoglobin levels compared to the control group. Study also shows that, moringa leaf flour capsules are more effective in increasing hemoglobin levels than iron supplements and regularly consumption of cilok, a food containing Moringa leaves can increase hemoglobin level in teenage girls. After analyzing several articles, it has been found that consuming Moringa leaves in various forms can help female at different stages to absorb iron faster and increase their hemoglobin levels.

Introduction

Moringa oleifera belonging to the family of Moringaceae is an effective remedy for malnutrition (L. Gopalakrishnan *et al*., 2016). Moringa is a plant that has the potential to be commercially produced either as a cash crop or as part of agro forestry systems. By introducing Moringa into existing production systems, it can improve food production and biodiversity. Additionally, Moringa is a fast-growing and productive tree can help develop farm enterprises, ensuring better profitability and sustainability.

Moringa is rich in nutrition owing to the presence of a variety of essential phytochemicals present in its leaves, pods and seeds. In fact, Moringa is said to provide 7 times more vitamin C than oranges, 10 times more vitamin A than carrots, 17 times more calcium than milk, 9 times more protein than yoghurt, 15 times more potassium than bananas and 25 times more iron than spinach (Rockwood *et al.*, 2013). Moringa has lot of minerals that are essential for growth and development among which, calcium is considered as one of the important minerals for human growth. While 8 ounces of milk can provide 300–400 mg, Moringa leaves can provide 1000 mg and Moringa powder can provide more than 4000 mg. Moringa powder can be used as a substitute for iron tablets, hence as a treatment for anemia. Beef has only 2 mg of iron while Moringa leaf powder has 28 mg of iron. Moringa leaf can consume in different ways such as powder, flour, juice, cilok and as well as a teabags.

Blood that contains less iron can cause anemia. This nutritional case is the most common in almost all countries globally. In case of female, in every age group has the potential to experience anemia including adolescents.

According to World Health Organization (WHO), the global prevalence of anemia is 24.8%, which means about 1.62 billion people worldwide. It is noted that the highest prevalence is in preschool age children (47.4%), while the lowest prevalence is in men (12.7%). The prevalence rates for pregnant women and non-pregnant women are 41.8% and 30.2%, respectively (De Benoist*et al.*, 2008); however, among different population groups, the greatest number of individuals affected by anemia belongs to non-pregnant women, 468.4 million (Gebremedhin S *et al.*, 2011). Normal results for hemoglobin in general in case of female are 12.1 to 15.1 g/dL or 121 to 151 g/L. Female are more at risk for hemoglobin problem due to losing significant amounts of iron during menstruation. Female adolescents who experience anemia are more at risk for morbidity and mortality during their reproduction period (Teji K *et al.*, 2016).

Pregnancy undergoes a physiological process that is hemodilution. Pregnant women experience a decrease in blood plasma or an increase in blood cells unbalanced with an increase in blood volume, resulting in a blood-thinning with a peak of 32 weeks gestation. If not given the nutritional needs, there will be less hemoglobin. The pregnant women need adequate nutrition. Providing blood booster tablets is not sufficient to overcome the problem of hemoglobin levels in pregnant women. One way to overcome nutritional deficiencies is to meet the iron needs of pregnant women is to consume Moringa leaf flour which contains 28.2 mg of iron in per 100gm flour. In case of postpartum mothers Moringa oleifera leaves powder capsules can increase hemoglobin level. Improved hemoglobin levels in postpartum mothers may facilitate Exclusive breast feeding practices (Gandhi H &Arora D, 2023).

The UN's second sustainable development goal aims to end hunger and malnutrition by ensuring a continuous supply of sufficient, wholesome food which enables people to shift towards adopting healthier, well-balanced diets. In this case, Moringa can help achieve desirable outcomes by providing an excellent source of micronutrients through its leaves. These can then be used for food fortification to help the malnourished.

Materials and Methods

The research method used is a literature review study that tries to dig up more information about *Moringa oleifera* leaves at different form to increase hemoglobin levels in female. The literature review is based on secondary data obtained from a systematic search of computerized databases. A total of 5 research journals were reviewed. These research journals are used from 2020 to 2023. The analytical method used is using content analysis of online research journal documents obtained through searching trusted journal sites with inclusion criteria, namely research journal studying *Moringa oleifera* leaves to increase hemoglobin levels in female spanning the last 5 years, national and international class, having ISSN (International Standard of Serial Number) number in both print and electronic versions and there is a DOI (Digital Object Identifiers) in the journal.

Results

Table 1: Analysis of Literature Review Result

Sl.	Author	Title	Method	Purpose	Result
1	Yusnidar *et al.*, 2020	The importance of *Moringa oleifera* leaf flour for pregnant women hemoglobin.	A Randomized, double blind pretest & post test controlled design.	The study investigated the effect of *Moringa oleifera* leaf meal in pregnant women on hemoglobin.	As part of a study, pregnant women who were at least 28 weeks into their pregnancy were split into two groups. The first group was given Moringa leaf flour capsules, while the second group was given iron supplements twice a day for 60 days. Both groups showed a difference in hemoglobin levels before and after the intervention. However, the group given Moringa leaf flour capsules showed a significant increase in hemoglobin levels compared to the iron group, with a p value of 0.001 (<0.05). The iron group had an average difference of 0.76, while the Moringa group had a mean difference of 1.46. This indicates that moringa leaf flour capsules are more effective in increasing hemoglobin levels than iron supplements.
2	Tirwati GA *et al.*, 2021	*Moringa oleifera* Teabags increase	This research used a Pre-post-test one group design with 100 female adolescents was used in this research. The treatment was carried	The Study aims to determine the effect of *Moringa oleifera* teabags on increased	An increase in the average of Hb (mean) before the intervention was 10.71 g/dl. After 15 days intervention it was 11.03 g/dl and after 30 days the average Hb was 11.63 g/dl at p< 0.05.

Table 1: (continued)

Sl.	Author	Title	Method	Purpose	Result
		Hemoglobin in Adolescent Females.	out by giving *M. oleifera* teabags 2 times one sachet (3 g) in the morning and one sachet (3 g) in the evening with two teaspoons of granulated sugar and dipped in 250 ml hot water.	Hemoglobin (Hb) in adolescent girls.	These result indicated a significant difference between Hb before and after the intervention.
3	Bidyani T & Thakur R, 2022	Effects of *Moringa oleifera* leave juice to incrase the haemoglobin level among anemic females.	Quasi experimental non randomized control group design (non-equivalent control group with pretest and post test design)	The study is known the effect of *Moringa oleifera* leaves juice to increase the hemoglobin level among anemic females.	The study revealed the mean score and standard deviation between pretest and post-test in experimental group, the mean score was increased 9.6 to 10.9 and showing the difference of 1.33 at p < 0.05 level of significance. And in control group the mean score increased by 0.3. The reason might be due to extraneous variable. It is inferred that the administration of the *Moringa oleifera* leaves juice among anemic female had a significant increase in post test hemoglobin level.
4.	Dian Soekmawaty Riezqy Ariendha *et al.*, 2022	The Effect of Moringa Leaf Cilok Supply on Hemoglobin Levels of Female Adolescents with Anemia.	Quasi experimental research with pre test and post test design. There were two groups, 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 control group was given iron tablet twice a day.	The research aims to identify the effect of moringa leaf cilok supply on hemoglobin levels of female adolescents with anemia.	Normal Hemoglobin levels in female adolescents are >12 g/dl. Thus teenage girls considered anemic if the Hb level is <12 g/dL. The study gave moringa leaf cilok to adolescent girls with anemia for 15 days. The result shows that consuming cilok regularly can increase hemoglobin level in teenage girls tested on day 16 at p.0.05.
5.	Gandhi H & Arora D, 2023	Post-partum iron deficiency anemia: Prevalence and impact of *Moringa oleifera* leaves powder on hemoglobin levels in post partum period.	Quantitative interventional study was conducted with pre test & post test with control group. The interventional group was administered moringa leaves powder capsules twice daily for 30 days. Each capsule contained 250mg of *Moringa oleifera* leaves powder. The control group was administered Placebo Capsules containing starch powder with a dosage of 250mg twice daily for 30 days.	The study investigated the impact of *Moringa oleifera* leaves powder capsules on hemoglobin levels of post partum mothers.	Findings of the study revealed the prevalence of iron deficiency anemia to be 59% in postpartum mothers post-delivery. Hemoglobin baseline mean values for experimental and control group was 10.9± 1.4 g/dl and 10.3±1.5 g/dl respectively on day 0 (baseline) post-partum. On day 7 (end line) post partum, the mean end-line hemoglobin values for the experimental and control groups were 12.3 ± 1.5 g/dl and 11.6 ± 1.6 g/dl respectively. The rise in hemoglobin levels was 1.4g/dl for the experimental group and 0.8g/dl for the control group, which was statistically significant (p=00001). This indicates that the experimental group had a greater increase in hemoglobin levels compared to the control group.

Discussion

Food based approach to prevent hemoglobin problem is the most sustainable strategy. Post-partum anemia is a cause of concern in urban setting. *Moringa oleifera* leaves capsules have significant impact on hemoglobin levels of lactating mothers (Gandhi & Arora, 2023).

Moringa leaves have nutritional content, that is seven times vitamin c in citrus fruits, four times vitamin A in carrots, four times calcium in milk, three times potassium in bananas, two times iron in spinach, two times protein found in yogurt or protein in an egg (Nucahyati E, 2015). Moringa leaf flour gives more results in increasing hemoglobin than Fe administration. It may be caused by several factors, such as the dosage of Moringa leaf flour given is 2000mg/day, where content is not much lost in Moringa leaf flour such as vitamin c, which can help the process of absorption of iron more quickly (Estiyani A *et al*, 2017) when compared with iron tablet which only contain 60 mg of iron and 500 mg of folic acid (Yusnidar *et al.*, 2020).

If the hemoglobin level falls below the standard limit, it is recognized as an anemia problem. In females, a normal hemoglobin level is above 12g/dl. Therefore, girls are

considered anemic if their hemoglobin level is less than 12 g/dL. The causes of anemia may include lack of nutritional deficiency due to low intake of animal and vegetable nutrients, both of which are sources of iron that play a vital role in the formation of hemoglobin. Moringa leaves contain high amounts of vitamin A, vitamin B, vitamin C, calcium, potassium, iron, and protein, all of which are easily digested by the human body. By regularly consuming Moringa leaf cilok, teenage girls can increase their hemoglobin levels as the vitamin C content in Moringa leaf extract aids the absorption of iron in the body (Dian Soekmawaty Riezqy Ariendha *et al*., 2022).

Moringa leaves have considerable potential for nutrients, various macro and micronutrients and active ingredients act as antioxidants. Furthermore, it contains essential nutrients such as 28.2 mg Fe, 2003.0 mg calcium and 16.3 mg vitamin a. Other nutrients include protein, c, vitamin D vitamin e, Vitamin K, Vitamin B. The Vitamin C content in Moringa leaf extract also facilitates iron absorption (Suriati, 2018). Based on various studies moringa leaves packaged in tea bags are easy to consume and safe. The recommended dose is 5 g/day, about one tea bag in the morning (2.5 g) and one tea bag in the evening. However moringa leaf tea can be a source of oxditants, anti-inflammatory and high nutrients and has an effect on increasing hemoglobin level of female. (Tirwati GA *et al*., 2021).

Conclusions

Based on the results of various studies, it can be inferred that the consumption of *Moringa oleifera* leaves in different forms can expedite the absorption of iron and boost the production of red blood cells. This ultimately leads to an increase in hemoglobin levels in female at different stages.

In order to reduce the likelihood of hemoglobin problems, it is recommended that female incorporate *Moringa oleifera* leaves into their diet in various forms. Overall *Moringa oleifera* leaves are becoming popular for use in food products that are both nutritious and therapeutically active. However, more clinical trials are necessary to determine their safety for consumption. Researchers must also investigate the bioavailability of moringa polyphenols and their bioaccessibility when complexed with other compounds.

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