

Research article

Comparison of the Effectiveness of Moringa Oleifera Leaf Powder Versus Extract on Hemoglobin Levels in Adolescent Girls: A Systematic Literature Review

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Abstract.

Moringa oleifera leaves contain high levels of iron, protein and vitamin C which can help increase hemoglobin (Hb) levels. This study aimed to examine the literature comparing the effectiveness of giving *Moringa oleifera* leaf powder (MoLP) vs. *Moringa oleifera* leaf extract (MoLE) to increase Hb levels in adolescent girls. This was a systematic literature review. Articles were found by searching Google Scholar, e-resources of national libraries, GARUDA and web journals accredited by SINTA. According to the findings of this literature study, 25 mg/day of MoLP can be an effective dose to increase Hb levels in adolescent girls for the long term (3 months) with an increase in Hb of 1.4 g/dL; a dose of 2100 mg/day can be effective for the medium term (1 month) with an increase in Hb of 1.75 g/dL; and a dose of 500 mg/day can be effective for the short term (14 days) with an increase in Hb of 1.0134 g/dl. The results also showed that 1000 mg/day of MoLE can be effective to increase Hb levels in adolescent girls for the long term (3 months) with an increase in Hb of 1.68 g/dL; and 1400 mg/day can be effective for the short term (21 days) with an increase in Hb of 0.749 g/dL. The administration of MoLP was found to be more effective in increasing the Hb level of adolescent girls compared to the administration of MoLE. It is recommended that future researchers conduct comparative studies on the effectiveness of giving MoLP, MoLE and Fe tablet supplements to increase Hb levels in adolescent girls.

Keywords: Moringa olivera leaf powder (MoLP), Moringa olivera leaf extract (MoLE), Hb levels, adolescent girls, systematic literature review

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1. Introduction

Iron Deficiency Anemia (IDA) in adolescent girls can cause lethargy, fatigue, weakness, tired and neglect accompanied by headaches or dizziness, dizzy eyes, drowsiness, and impaired concentration due to very low oxygen levels in brain tissue and muscles. Furthermore, it can cause fatigue, decreased physical fitness, which causes various activities at school and outside of school to be disrupted. IDA also causes the ability to concentrate on learning to decrease which has an impact on the learning achievement

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index [1]. In addition, anemia can lower the body's immunity which makes adolescents susceptible to infectious diseases. The need for iron that is not fulfilled in adolescence can then cause IDA during pregnancy. IDA in pregnancy often causes low birth weight (LBW) babies, premature babies, and increases the risk of infant and maternal mortality [2].

Based on the results of the Basic Health Research of the Republic of Indonesia (Riskesdas RI) in 2018, the prevalence of IDA in Indonesia was more found in the age range of 15 to 24 years, which was 84.6%. In general, efforts to treat anemia in adolescent girls can be done through pharmacological and non-pharmacological therapy. Pharmacologically, that is with a blood-supplementing tablet (Tablet Tambah Darah or TTD) of 1 tablet per week in a row for a year or as many as 52 tablets. This refers to government regulations based Surat Edaran Direktorat Jenderal Kesehatan Masyarakat Republik Indonesia No. HK. 03.03/ V/ 0595/ 2016. Data from the Ministry of Health of the Republic of Indonesia, 2018 shows that a total of 23.8% of adolescent girls in Indonesia do not receive a blood-supplementing tablet (TTD). A total of 98.6% of adolescent girls consume less than 52 iron supplements [3].

Non-pharmacological IDA handling, one of which is by giving *Moringa oleifera* Leaves is considered quite effective. Moringa leaves contain iron of 28.2 mg per 100 grams of dry leaves. Fe content is 25 times greater than spinach, 3 times greater than almonds, and 1.77 times greater absorbed into the body's blood. In addition, Moringa leaves contain lots of vitamin C which can help absorb iron (enhancer). Moringa leaves contain vitamin C of 220 mg per 100 grams of fresh leaves. It is 7 times larger than orange and 10 times larger than grape. Based on this, Moringa leaves can be an alternative to overcome IDA in adolescent girls [4].

MoLP is a simple product of dried fresh Moringa leaves. MoLE is the result of the process of extracting water from fresh Moringa leaves which are taken from the extract of Moringa leaves which are then processed by an advanced process so that they become a more concentrated powder form. Research [5] showed that giving MoLP at a dose of 2100 mg for one month could significantly increase Hb levels with an average increase of 1.76 ± 0.80 g/dL [5]. Research by [6] showed that giving MoLE with an intervention duration of three months showed a significant difference in hemoglobin levels with an average increase in Hb levels of 1.62 g/dL [6]. Giving MoLE capsules had an effect on increasing Hb levels in adolescent girls [7].

This study aims to analyze the comparison of the effectiveness of giving MoLP and MoLE to increase Hb levels in adolescent girls based on previous studies and literatures.

2. Methods

The type of research conducted is library research using a Systematic Literature Review (SLR) method. The independent variables in this study were MoLP and MoLE in capsule preparations, and the dependent variable was the Hb level of adolescent girls.

Search strategies.

Data collection is done through searching for information from books, books, journals, other reports related to research. The literature search engine uses Google Scholar, National Library E-resources, GARUDA, and web journals accredited by SINTA and Scopus. Data collection using the PICOT (Population, Intervention, Comparison, Output, Time) method. Data analysis uses critical appraisal. The keywords used by the researchers were "Moringa oleifera Leaves Powder, Moringa oleifera Leaves Extract, MoLP capsules, MoLE capsules, hemoglobin levels, anemia, adolescent girls".

Inclusion and Exclusion Criteria.

The journal inclusion criteria used in the study are as follows:

- a. The journals used come from trusted sources such as ScienceDirect, Google Scholar, NCBI, GARUDA, and web journals accredited by SINTA or web journals indexed by Scopus or reputable.
- b. The national journals used are journals that have been indexed by SINTA, Scopus or have an ISSN number.
- c. Moringa leaves used in the form of nutrition MoLP and MoLE in capsules.
- d. The journal used as a comparison is an experimental research journal with a control group on nutrition of MoLP and MoLE in capsules, with adolescent girls research subjects.
- e. The research design used is a true research design or a true experiment, a quasi-experimental design using a pretest-posttest design with control group design.

The journal exclusion criteria used in the study are as follows:

1. Journals are not indexed by SINTA, or Scopus.
2. The journal did not use MoLE, and or MoLP in capsule preparations.
3. Using an experimental design without a control group.
4. Not Meet the PICOT critical appraisal criteria.
5. The research journals reviewed published before year 2000.

3. Data extraction

Literature search results from electronic databases get more than 1000 experimental studies. Screening journals by evaluating the suitability of journals about research on the effect of giving MoLP and MoLE capsules on increasing Hb levels, found 55 journals about MoLP, 39 journals about MoLE and 2 proceedings about MoLE.

The narrowing of the journals found was done through adjustments to the inclusion criteria, then nine journals were obtained. Researchers assessed the journal with a critical appraisal by categorizing groups with ten categories including: clear problem topics, suitability of problems with needs, research methods, population and samples, interventions carried out, data collection techniques, data collection procedures, data validity and reliability, results and data analysis.

Based on the results of the assessment that has been done, the journals are grouped into 3 groups, namely 4 below average papers, 5 average papers. Some of the journals obtained have been indexed by SINTA as many as 3 journals, and international journals indexed by 2 journals. The journals used are journals from 2016-2021.

3.1. Quality of appraisal

It is well known in the evidence-based medicine practice that framing the research question is the most important and crucial part of the research integrity. Population, Intervention, Comparison, Outcome, and Time (PICOT) is a specialized framework used by most researchers to formulate a research question and to facilitate literature review. The aim of this study is to investigate the representation of the PICOT frame in the title of published articles in three different *Moringa oleifera* Leaves journals.

P is defined as the population used or a problem under study, namely young women. I is defined as an action or treatment given to the population in accordance with the research topic, namely the provision of MoLP and MoLE nutrition in capsules. C is another action or treatment used as a comparison. O is the desired outcome or outcome according to the research topic (increased Hb levels). T is defined as the time of publication of articles used in research journals.

4. Results

Creating a Systematic Review research protocol using PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-analyses)

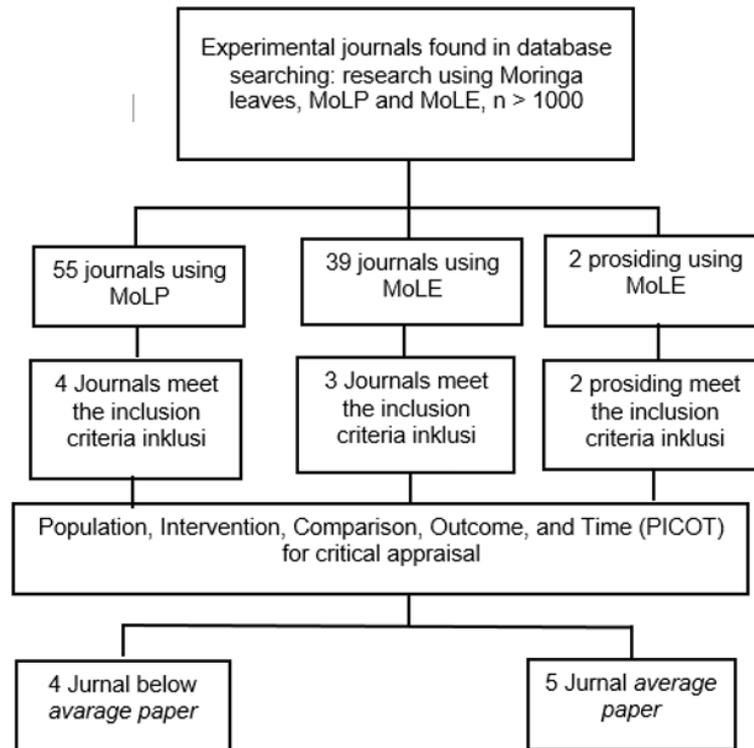


Figure 1: Prisma Flow Diagram.

In the following, the effect of giving MoLP, MoLE, and TTD on increasing Hb levels in adolescent girls is presented based on the results of previous studies.

Table 1 The effect of MoLP, MoLE, and TTD on increasing Hb levels in adolescent girls shows that, the administration of MoLP at a dose of 25 mg/day for 3 months had the effect of increasing Hb levels by 1.4 g/dL [8]. Giving MoLP at a dose of 2100 mg/day for 1 month can increase Hb levels by 1.75 g/dL [5]. Administration of MoLP at a dose of 500 mg/day for 14 days can increase Hb levels by 1.0134 g/dL [9]. Then giving MoLE at a dose of 2000 mg/day for 3 months has the effect of increasing Hb levels by 1.68 g/dL [6]. Administration of MoLE at a dose of 500 mg/day for 3 months can increase Hb levels by 2.73 g/dL [9]. Administration of MoLE at a dose of 1400 mg/day for 21 days can increase Hb levels by 0.79 g/dL [10]. Administration of TTD at a dose of 60 mg/day for 3 months can increase Hb levels by 0.3 and 0.9 [7], administration of TTD at a dose of 60 mg/day for 10 months cannot increase Hb levels as seen from P value = 0.23 [11], and administration of TTD at a dose of 300 mg/day for 21 days can increase Hb levels by 0.64 g/dL [10].

Comparison of the effectiveness between the administration of MoLP and MoLE was only carried out in 2 journals with the same duration of intervention (3 months) [7,8].

TABLE 1: The effect of MoLP, MoLE, and TTD on increasing Hb levels in adolescent girls.

MoLP Researcher	Dose/day (mg)	Duration	Sample	Preparation Type	P Value	Hb level (g/dL)		↑Hb (g/dL)
						Pre	Post	
Choudary, M., Singh, S., & Patel, C. R. (2020)	25mg	3 months	Adolescent girls	MoLP	-	9,6	11	1.4
Hamidiyah, A., & Rohmani, L. (2021).	-	10 months	Adolescent girls	MoLP	0,062	-	-	0.59
Indriani, L., Zaddana, C., Nurdin, N. M., & Maryati, S. (2019)	2100 mg	30 days	Adolescent girls	MoLP	0,000	10,65± 0,69	12,40±0,59	1.75
Fitriyaa, M. (2020).	500 mg	14 days	Adolescent girls	MoLP	0,000	10.8033	11.8167	1.0134
MoLE								
Yulianti, H., Hadje, V., & Alasiry, E. (2016).	2000 mg	3 months	Adolescent girls	MOLE	0.000	9.59±0.49	11.27±0.41	1.68
	-	3 months	Adolescent girls	MOLE	0.000	10.37±0.42	12.35±0.47	1.62
Nur Anisa, sri wahyuni, sri rahayu, aulia choirunnisa, listyaning eko martanti. (2019)	500 mg	3 months	Adolescent girls	MOLE	0,001	9.37	12.10	2.73
Suzana, D., Suyatna, F. D., Azizahwati, Andrajati, R., Sari, S. P., & Mun'im, A. (2017).	1400 mg	21 days	Adolescent girls	MOLE	0,001	10.58	11.37	0.79
Sartika, W., . H., & Suryarinih, Y. (2019).	-	7 months	Adolescent girls	MOLE		10.63	13.22	1.59
TTD								
Hamidiyah, A., & Rohmani, L. (2021).	60 mg	10 months	Adolescent girls	TTD	0.23	-	-	-
Yulianti Anwar ¹ , Veni Hadju ² , Samrichar R1, Andi Alimuddin Unde ³ , Andi Nilawati Usman ¹ , Ni Luh Putu Herli Mastuti ⁴	60 mg	3 months	Adolescent girls	TTD	0,011	9.88±0.48	10.18±0.69	0.3
Nur Anisa, Sri Wahyuni, Sri Rahayu, Aulia Choirunnisa, Listyaning Eko Martanti	60 mg	3 months	Adolescent girls	TTD	0.001	9.09	10.08	0.99
Suzana, D., Suyatna, F. D., Azizahwati, Andrajati, R., Sari, S. P., & Mun'im, A. (2017).	300 mg	21 days	Adolescent girls	TTD	0,004	10.93±1.02	10.93±1.02	0.64

The author calculated the dose of shrinkage of fresh leaves to dry leaves by 20%, the result was that a dose of 25 mg MoLP was equivalent to a dose of 50 mg MoLE.

TABLE 2: Comparison of the effectiveness between MoLP and MoLE on increasing Hb levels in adolescent girls FROM Included Study.

Researchers	Dose/day (mg)	duration	Sample	Preparatic Type	P Value	Hb Level (g/dL)		↑Hb (g/dL)
Choudary, M., Singh, S., & Patel, C. R. (2020)	25mg	3 months	Adolescent girls	MoLP	-	9,6	11	1.4
Anwar, Y., Hadju, V., R. S., Unde, A. A., Usman, A. N., & Mastuti, N. luh P. H. (2020)	2000 mg	3 months	Adolescent girls	MoLE	0.000	9.59±0.49	11.27±0.41	1.68

The administration of MoLE at a dose of 2000 mg/day is equivalent to 200 mg of MoLP, so it can be seen that the administration of MoLP at a dose of 25 mg/day has increased Hb levels by 1.4 g/dL, while the administration of MoLE at a dose of 2000 mg/day has increased by 1.68 g. /dL. This shows that MoLP is more effective in increasing Hb levels than MoLE.

5. Discussion

Moringa leaves are efficacious to overcome various kinds of complaints caused by vitamin and mineral deficiencies, one of which is iron deficiency or anemia. In addition, Moringa plants are also a source of iron (31% daily value requirement per 100 grams) [12]. The study of [8] showed that giving MoLP a dose of 25 mg for 3 months had a positive relationship to increase Hb levels in adolescent girls by 1.4 g/dL [8]. The composition of the MoLP used in this study contained 0.85 mg of iron in fresh Moringa leaves and after drying it became 24 mg and for protein content, namely 6.7 mg in fresh leaves and after drying it became 23.66 mg. This study conducted a 24-hour recall consumption survey, to determine the nutritional intake consumed by respondents during the 3 months of intervention. The results show that the respondents' average calorie intake is 1850 Kcal, protein 42 g, fat 29 g, calcium 541 mg, iron 18.5 mg and vitamin A 452 mg, this means that the respondent's nutritional intake (except fat) is still below the RDA for the age group 13-5 years. A total of 84% of respondents are vegetarians. The results of this study are who said that after giving MoLP supplements to women aged 15-45 years, they had a significant increase in Hb levels (p-value < 0.05) [8].

The study of [11] showed there is no difference in Hb levels before and after consuming MOLP capsules, there is no difference in Hb levels before and after taking TTD, and there is a difference in Hb levels before and after consuming MOLP and TTD [11].

TTD contains 60 mg of elemental iron and 0.4 mg of folic acid which plays an important role in the formation of Hb levels in the body. The iron tablets chosen for the treatment of iron nutritional anemia are ferrous sulfate because the absorption of ferrous salts is three times more optimal than other ferrous salts such as fumarate, succinate, gluconate, or other salts [1]. MoLP's high nutritional content, and vitamin C content helps iron absorption, so that giving MOLP and TTD is more effective than giving MOLP alone or TTD alone. The results of food recall in relation to the consumption of food sources of enhancer and inhibitor respondents were not presented by the researcher. Enhancers such as vitamin C are very good at helping increase Fe absorption, whereas inhibitors such as phytic acid and tannins interfere with Fe absorption [2].

Research by [5] showed that knowledge, consumption patterns (intake of Fe and vitamin B12), and stress levels did not differ between groups (P value > 0.05). There are differences in Hb levels between the two groups (P value < 0.05). There was an increase in Hb levels in the MOLP and education groups, as well as in the education group [5].

Research by [13] showed that giving MOLP a dose of 500 mg for 14 days had a significant effect (P value = 0.000) on increasing Hb levels in adolescent girls. Before the intervention, respondents with mild anemia were 90% and those with moderate anemia were 10%, after the intervention, respondents with mild anemia were 33%, and respondents with normal Hb levels were 67%. Moringa leaves contain a lot of mineral compounds including Fe as much as 177.74 ppm. The high mineral content in Moringa leaves is caused by the decreased water content in MoLP, so that the mineral content becomes more concentrated and increases. Iron (Fe) cannot be damaged by heating except for heme iron, light radiation, oxygen or by acidity, but can be lost by physical treatment [14]. The average increase in Hb levels in each respondent before the intervention was 10.8033 gr% with the smallest value being 7.70 gr% and the largest being 11.9 gr%. Meanwhile, after the intervention, the average Hb level increased to 11.8167 g% with the smallest value being 8.40 g% and the largest being 15.30 g% [13]. This is due to the high iron content in MOLP which is 25 times higher than spinach, so it can be an alternative to overcome iron nutritional anemia.

MoLE has an effect on increasing Hb levels in adolescent girls. Research by [7] stated that MoLE with a dose of 1000 mg consumed 2 times per day for 2 months had a significant difference (P value = 0.000) with an average increase in Hb levels of 1.68 g/dL. The content of vitamin C contained in MoLE is more than in MoLP, this makes the

absorption of iron in the body faster. The content of vitamin C per 100 g of Moringa leaf extract is 1514.96 mg [15]. This research found that giving MoLE supplements at a dose of 2000 mg per day for 2 months is still not enough to increase Hb levels because it is influenced by various factors including menstrual periods, diet, unbalanced nutritional intake and stress. So it is necessary to increase the dose to 800 mg which is consumed twice a day so that the increase in Hb levels is more effective [7].

Research by [6] stated that there was a significant difference (P value = 0.000) in Hb levels in the intervention group, but not in the control group. Prior to the intervention, 100% of the intervention group experienced mild anemia and 10% of the control group had mild anemia, whereas after the administration of MoLE, those who experienced mild anemia in the intervention group became 13% from initially 100%, while in the control group after the intervention who had mild anemia initially 0% and became 10%. This shows that most of the respondents who received the MOLE supplement had their Hb levels normal. The average increase in Hb levels after giving MOLE for 3 months was 1.62 g/dL. Giving MOLE with a dose of 600 mg / day can increase red blood cells by 30%. Dried Moringa leaves contain very high protein, iron, vitamin A and vitamin C, so giving MOLE is very good for overcoming the problem of iron nutritional anemia. Giving MOLE for 3 months can increase the average Hb level in the intervention group before treatment, which is 10.73 ± 0.42 and after the intervention the average Hb level increases to 12.35 ± 0.47 , but in the intervention group there is still a minimum Hb level of 11,68 gr/dL. Based on laboratory results, it is known that the nutritional content of the South Sulawesi variety MOLE contains protein levels of 25.25%, Fe of 91.72 mg, vitamin C 1125.71 mg per 100 grams of Moringa leaves. This shows that giving MOLE is considered more efficient to prevent and maintain Hb levels in normal conditions.

This is in line with research conducted by [9] which showed that there was a significant difference in Hb levels (P value = 0.002) between the intervention group given a combination of MoLE with vitamin C, and there was a difference significant (P value 0.001) between the intervention group and the control group, with an average Hb level of 12.1, the highest Hb value 14.1 and the lowest Hb 10. According to [16] Moringa leaves contain nutrients, minerals and essential amino acids. Moringa leaves contain 2 times higher protein than yogurt and 7 times higher vitamin C than oranges [16]. The high vitamin C content in Moringa leaves can help in the absorption of iron in the body. In this study, researchers combined MOLE supplementation with vitamin C, because vitamin C plays a very important role in the formation of erythrocytes. Vitamin C consumed can help in reducing ferric iron to ferrous which is easier to absorb by the small intestine. In addition, vitamin C can also increase 4 times greater in the absorption of non-heme

iron in the body, because vitamin C can inhibit the formation of hemosiderin which is not easily mobilized and liberate Fe if needed. So, it is highly recommended to take Fe supplements in combination with orange juice or other vitamin C²⁴. This is supported by the research of [17] which showed that there was a difference in the effect of supplementation of Fe tablets with and without vitamin C on Hb levels in pregnant women, where the results showed that consumption of Fe tablets with vitamin C was more effective in increase Hb levels in pregnant women. In this study, combining the consumption of MOLE supplements with vitamin C caused Hb levels to increase from 9.37 to 12.10 g/dL, with an increase of 2.7 g/dL [17].

The research of [10] showed that there was a significant difference (P value = 0.001) giving MoLE at a dose of 1400 mg with a combination of 200 mg ferrous sulfate to increase Hb levels in iron deficiency anemia patients with an average increase in Hb levels of 0.749 ± 0.81 g/dL with P-value = 0.001, while in the control group it was 0.644 ± 0.83 g/dL with P-value = 0.004. Although both groups were significant, the average increase in Hb levels was greater in the intervention group given MoLE capsules and ferrous sulfate. The nutritional content of the MoLE capsule at a dose of 700 mg contains 0.103 mg/capsule of iron, 5,313 mg of vitamin C/capsule and 39,043 mg/capsule of protein. Moringa leaves have the same protein content twice and four times greater than cinnamon and spinach, iron contained in Moringa leaves is four times greater than spinach and five times greater than cinnamon, while vitamin C contained in leaves Moringa is 15 times higher than spinach. However, based on this study, MoLE capsules had no effect on the increase in red blood cells in patients with iron deficiency anemia with Pvalue = 0.384 [10].

Research by [18] showed that after administration of MOLE capsules in the case group the average Hb level increased to 13.22 mg/dL and in the control group it also increased to 12.28 mg/dL. However, in the control group there was no significant difference in the average Hb levels before and after the intervention (P-value = 0.091), while in the case group (P-value = 0.000) [18]. According to [19] Hb levels can be normal if after four to ten weeks of intervention [19]. In this study, the researchers conducted interviews regarding the consumption of iron and vitamin C and conducted a food recall, which may be an influence in increasing Hb levels in the control group and the case group. However, the results of interviews and food recalls are not presented in this journal, so it is not known whether the food consumption consumed by respondents affects the increase in Hb levels or not [18].

Based on the analysis of research journals that used the control group by giving iron tablets, it was found that the research conducted by [11] showed that most of the

respondents who consumed 63% iron tablets did not experience an increase in Hb levels, and those who experienced an increase in Hb levels were 37. %. And based on the results of statistical tests showed that there was no significant difference (Pvalue 0.23) Hb levels before and after consuming iron tablets with the average Hb levels in respondents before and after consuming iron tablets of -0.3 g/dL [11]. This is not in line with the research conducted by [20] that there is an effect of giving TTD to adolescent girls on increasing Hb levels given for 2 months every Wednesday [20].

In contrast to the research conducted by [7,9] for 2 months of TTD administration there was an increase in Hb levels in adolescent girls with Pvalue = 0.011 and 0.001. In a study conducted by [7] showed the results of changes in Hb levels in respondents who were given TTD of 46.6% experienced an increase in Hb levels of 0.1-0.5 g/dL, while in the code B group an increase in Hb levels of 40% with an increase of 1.1-2.0 g/dL. The average Hb level in the respondents before being given an TTD was 9.88 g/dL and after giving the TTD, the average Hb level was 10.18 g/dL [7,9]. The results of this study are in line with research conducted by [21] which showed that there was a difference in Hb levels before and after administration of iron tablets with P value = 0.001 [21]. Meanwhile, research conducted by [10] showed that there was a significant difference in the average Hb level in the control group who received iron sulfate tablets with a dose of 300 mg. Giving iron sulfate 300 mg or 60 mg iron once or twice for three to four weeks can increase Hb levels by 1-2 g/dL [10].

Giving TTD in increasing Hb levels in adolescent girls, it was seen that the increase in Hb levels was not as large as those given by MoLP and MoLE. Because in TTD there is no nutritional content of vitamin C, protein and amino acids. TTD contains only the equivalent of 60 mg of elemental iron and 0.4 mg of folic acid. In contrast to MoLP and MoLE which contain vitamin C and protein in them, the consumption of TTD must be accompanied by the intake of foods rich in nutrients that help in the absorption of iron, for example by consuming fruit sources of vitamin C (oranges, papaya, mango, guava, and other fruits), and must also be assisted by the consumption of animal protein sources such as red dging, fish, liver, and others. Giving iron tablets to adolescent girls also has side effects such as nausea, flatulence and difficulty defecating, so that it affects the level of adherence to iron tablets consumption in adolescent girls.

From the discussion of the nine journals above, it is not possible to see a comparison of the effectiveness between giving MOLP and MOLE to increase Hb levels in adolescent girls in all journals, because the dose and duration of the intervention were different. However, there are several journals that conduct MOLP and MOLE interventions in the same duration, namely for three months, the study was conducted by [8] for the MOLP

intervention and for the MOLE intervention carried out by [7]. According to [22], the shrinkage of fresh Moringa leaves to Moringa leaf powder is 20%, therefore a dose of 1000 mg MOLE is equivalent to a dose of 200 mg MOLP [8,22].

The study conducted by [8] by giving MOLP at a dose of 25 mg for three months effectively increased Hb levels by 1.4 g/dL, while for the study conducted by [7] giving MOLE at a dose of 1.4 g/dL. 1000 mg or equivalent to a dose of 200 mg MOLP is effective in increasing Hb levels by 1.68 g/dL, it can be seen that MOLP is more effective in increasing Hb levels compared to MOLE, because some nutrients contained in MOLP are higher than MOLE, it can be seen in the table below:

TABLE 3: Nutritional content of fresh and dried Moringa leaves (per 100 g).

Nutrient Contents	Fresh leaves	Dried Leaves
Besi (mg)	0,85	25,60
Vitamin C	220,00	15,80
Protein	6,70	29,40
Folate (µg)	40	23

Source: Susilowati et al. (2020)

From the table 3, it can be seen that the nutrients contained in MoLP are higher than MoLE, but the vitamin C content is higher in MoLE because MoLP undergoes a drying process in its manufacture which causes the vitamin C content to decrease.

In the MoLP the iron content is 25.60 mg and at the MoLE 0.85, it can be seen that the iron in the MoLP is much greater than the MoLE. Iron is an essential micronutrient needed by every cell of the body. Iron in the body functions as a carrier of oxygen and electrons, as well as a link for oxygenation, hydrolysis, and other metabolic processes with its ability to change between ferrous and oxidizing phases. In the body, iron combines with protein so that it can receive and release oxygen and carbon dioxide. The amount of iron in the body varies according to age, gender, nutritional status and the amount of iron reserves. In young women, the iron requirement per day is between 20-26 mg per day, so it can be seen that the iron content in 100 grams of MoLP has met the iron requirement based on the RDA table, while the iron content in the MoLE of 0.85 mg is not sufficient based on the iron requirement. RDA in adolescent girls.

The vitamin C content in MoLE is higher than MoLP, the vitamin C content in MoLE is 220 mg and in MoLP is 15.80 mg. Vitamin C is a water-soluble vitamin that functions to increase iron absorption in the body[24]. Moringa leaves contain very high vitamin C, so it is very helpful in the process of absorption of iron in the body and iron obtained from vegetables is not as fast as iron absorption from animals so it must be supported

by a high intake of vitamin C. However, the vitamin C content in MOLP is lower than vitamin C in MOLE, because in MOLP a drying process occurs which causes the vitamin C content to shrink, because vitamin C cannot withstand heating [25].

Moringa leaves also contain high enough protein. The protein in .MoLP is larger than the protein in MoLE. The protein content in MoLP is 29.40 grams and at MoLE is 6.70 grams. Protein functions in the formation of ferritin, if the protein in the body is lacking, the absorption of iron in the body will not be adequate. Protein needs in adolescent girls are around 60 grams for ages 10-12 years, 69 grams for ages 13-15 years, 59 grams for ages 16-18 years and 56 grams for ages 19-29 years. So it can be seen in 100 grams of MoLP and MoLE that it is not sufficient for young women's daily protein needs based on the RDA table, but the protein content in MoLP is greater than MoLE so it is more effective on MoLP. In addition, in 100 grams of MoLP contains 23 micro grams of folic acid and every 100 grams of MOLE contains 40 micro grams of folic acid, it can be seen that the content of folic acid is higher in MOLE compared to MOLE, but this is very far when compared to the RDA table.

Moringa leaves also contain 8 essential amino acids and 10 non-essential amino acids. Amino acids are the result of protein breakdown that is brought into cells to be used to form various types of proteins needed by the body [24]. Amino acids are absorbed through the walls of the gastrointestinal tract and distributed throughout the body. Amino acids that have been absorbed will be converted by the liver and some tissues into specific proteins. So it can be seen that Moringa leaves have quite a lot of nutritional content, so it can show a significant effect in giving MoLP and MoLE capsules which can increase Hb levels in adolescent girls.

Many factors influence the occurrence of anemia, namely from food consumption, nutritional status, duration of menstruation, knowledge of anemia, and socio economic [25]. Consumption of food is very influential on the process of absorption of iron in the body. Substances that can inhibit the process of iron absorption in the body are consuming a lot of coffee and tea. Coffee contains caffeine which can inhibit the process of iron absorption. Tea and chocolate also contain caffeine-type stimulants called theobromine and tannins [26]. Coffee, tea, and chocolate are inhibitors of iron absorption and should be avoided. To help the process of iron absorption, it must be supported by consumption that contains protein and vitamin C which are enhancers in the iron absorption process. Therefore, the consumption of MoLP, MoLE, and TTD capsules must be balanced with the consumption of appropriate food so that the process of iron absorption and the formation of Hb levels in the body is optimal.

The administration of MoLP is more practical than the administration of MoLE, because the shelf life of MoLP capsules is longer and MoLP capsules are easy to store [24]. In addition, it is not only given in capsules, but can be directly sprinkled into food as food fortification so that it is more practical than MOLE and causes young women who consume it not to think that MOLP is a kind of supplement.

This research have several limitation. 1) Several journals in this literature review study used different doses and durations, so an analysis of the effectiveness of all journals could not be carried out. The effectiveness analysis was only carried out in several journals with the same dose and duration of intervention. 2) Some journals do not write down the dose of the intervention given, nor do they write down the Hb level (pre and post) so that the effectiveness of MoLE and MoLP cannot be analyzed. 3) The number of journals with the theme of the effect of giving MoLP and MoLE on increasing Hb levels in adolescent girls is very limited.

6. Conclusions

Giving MoLP is more effective in increasing Hb levels in adolescent girls than giving MoLE. MoLP and MoLE can be implicated as a supplement to increase Hb in adolescent girls. The next researcher needs to conduct a primary study that directly compares the administration of MoLP, MoLE, and TTD to the increase in Hb levels in adolescent girls.

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References

- [1] Susilowati S. Dasar ilmu gizi kesehatan masyarakat. Cimahi: CV Elfatih Media Insani; 2020.
- [2] Susilowati S, Kuspriyanto W. Gizi dalam daur kehidupan. Bandung: Refika Aditama; 2016.
- [3] Kemenkes RI. Hasil utama riskesdas 2018. Kementrian Kesehatan Republik Indonesia. Jakarta; 2018.
- [4] Krisnadi A. Kelor super nutrisi. Kelorina; 2012 November 28. Available from: <https://kelorina.com>

- [5] Indriani L, Zaddana C, Nurdin NM, Sijintak JSM. Pengaruh pemberian edukasi gizi dan kapsul serbuk daun kelor (*Moringa oleifera* L.) terhadap kenaikan kadar hemoglobin remaja putri di universitas pakuan. *Media Pharmaceutiaca Indonesiana*. 2019;2(4):200–7.
- [6] Yulianti H et al. Pengaruh ekstrak daun kelor terhadap peningkatan kadar hemoglobin pada remaja putri di SMU muhammadiyah kupang. *JST Kesehatan*. 2016;6(3):399–404.
- [7] Anwar Y, Hadju V, Alasyri E. Pemberian ekstrak daun kelor terhadap peningkatan kadar hemoglobin pada remaja putri putus sekolah usia 12–18 tahun. *Jurnal Kesehatan Manarang*. 2020;6(2):131–7.
- [8] Choudhary M, Sing SP, Patel CR. Effect of drumstick leaves supplementation for treating iron deficiency anemia in adolescence girls. *Journal Pharmacognosy and Phytochemistry*. 2020;9(3):1446–9.
- [9] Anisa N, Wahyuni S, Rahyu S, et.al. Effect of moringa leaves and vitamin C capsule combinations in increaseing hemoglobin levels of young women with anemia. *Proceedings of the International Conference on Applied Science and Health*. 2019: 0(4); 565–70.
- [10] Suzana D, Suyatna FD, Azizahwati A, et al. Effect of *Moringa oleifera* leaves extract against hematology and blood biochemical value of patients with iron deficiency anemia. *Journal Young Pharmacology*. 2019;9(1):S79-S84.
- [11] Hamidiyah A, Rohmani L. Pencegahan anemia santri putri melalui perbandingan konsumsi suplementasi tablet tambah darah dengan kapsul serbuk *Moringa oleifera* leaf. *Oksitosin J Ilm Kebidanan*. 2021;8(1):73–80.
- [12] Winarno F. Tanaman kelor (*Moringa oleifera*): Nilai gizi, manfaat, dan potensi usaha. Gramedia Pustaka Utama; Jakarta. 2018.
- [13] Kurniawati I, Fitriyya M, Wijayanti W. Karakteristik tepung daun kelor dengan metode pengeringan sinar matahari. *Prosiding Seminar Nasional Unimus, Semarang*. 2018;1(1):238-243.
- [14] Fitriyaa M, Wijayanti W. Upaya peningkatan kadar hemoglobin melalui suplemen tepung daun kelor pada remaja putri. *Proceeding of The URECOL*. 2020;0(0):86–94.
- [15] Zakaria H, Hadju V, Suryani AS, Bahar B. The effect of moringa leaf extract in breastfeeding mothers against anemia status and breast milk iron content. *International Journal Science of Basic and Applied Research*. 2015;24(1):321–9.

- [16] Susilowati S, Irianto G. Masih tentang kelor moringa oleifera lam. Pemanfaatan di tingkat rumah tangga untuk perbaikan gizi dan derajat kesehatan masyarakat. 2nd ed. Cimahi: Elfatih Media Insani; 2020.
- [17] Asiyah S, Rahayu DE, Isnaeni WDN. Comparison of blood supplement with and without vitamin C on hemoglobin levels of pregnant woman at 16-32 weeks in Keniten Village, Mojo, Kediri. *Jurnal Ilmu Kesehatan*. 2017;3(1):76–81.
- [18] Sartika W, Suryarinilsih Y. The effect of moringa leaf capsule on the hemoglobin levels in young women at smp sabbihisma padang. *KnE Life Sciences*. 2019:158–64.
- [19] Bakta I. *Hematologi klinik ringkas*. EGC; Jakarta. 2006.
- [20] Tonasih T, Rahmatika SD, Irawan A. Efektifitas pemberian tablet tambah darah pada remaja terhadap peningkatan hemoglobin (Hb) di STIKes muhammadiyah cirebon. *Jurnal SMART Kebidanan*. 2019;6(2):106-113.
- [21] Haryanti E. Effects of Fe pill in increasing Hb levels on female teenagers in Lahat High School. *JPP (Jurnal Kesehat Poltekkes Palembang)*. 2020;15(2):135–9.
- [22] Hardiansyah MS, Supariasa I. *Science of nutrition: Theory and application*. Jakarta: EGC; 2016.
- [23] Aminah S, Yanis M, Permana AW. Kandungan nutrisi dan sifat fungsional tanaman kelor (*Moringa oleifera*). *Bul Pertan Perkota*. 2015;5(2):35–44.
- [24] Fikawati S, Syafiq A, Veratamala A. *Gizi anak remaja*. PT Raja Graf Persada; Depok. 2017.
- [25] Gunawan AW. *Food combining kombinasi makanan serasi pola makan untuk langsing & sehat*. 14th ed. Jakarta: PT. Gramedia Pustaka Utama; 2007.