



Effects of a mixture hylocereus polyrhizus (Red Dragon Fruit) juice and moringa leaf powder towards hemoglobin level in adolescent girls

Pengaruh campuran jus hylocereus polyrhizus (buah naga merah) dan tepung daun kelor terhadap kadar hemoglobin pada remaja putri

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Abstract

Nutritional anemia in adolescents has an impact on decreasing learning concentration and low learning achievement. Adolescent girls who are anemic are at risk of becoming anemic women of childbearing age, then becoming anemic mothers who can experience chronic energy deficiency during pregnancy later. Red dragon fruit and moringa leaves are known to have a high level of vitamin C, rich in iron, and other bioactive compound. However, the potency of the combination between Hylocereus polyrhizus juice and Moringa Leaf Powder towards Hemoglobin level in Adolescent girls is still remain unknown. The purpose of this study was to know the effect of giving a mixture of hylocereus polyrhizus juice and Moringa leaf powder on hemoglobin levels in adolescent girls. A Quasy Experimental study was conducted in this study with two intervention groups and one control group. A purposive sampling technique was used to select 60 students especially adolescent girls from Senior High School 3 in Bengkulu City in May 2022. Statistical analysis using One Way Anova test and Bonferonni Post Hoc test. A mixture of Hylocereus polyrhizus juice and moringa leaf powder was significantly associated with increasing hemoglobin levels than group that was given hylocereus polyrhizus juice only with p value = 0,000 (p <0,05).

Keywords: Anemia, hemoglobin, moringa leaf, hylocereus polyrhizus juice

Abstrak

Anemia gizi pada remaja berdampak pada penurunan konsentrasi belajar dan rendahnya prestasi belajar. Remaja putri yang mengalami anemia berisiko menjadi anemia pada wanita usia subur, kemudian menjadi ibu anemia yang dapat mengalami kekurangan energi kronis saat hamil nanti. Buah naga merah dan daun kelor diketahui memiliki kadar vitamin C yang tinggi, kaya zat besi, dan senyawa bioaktif lainnya. Namun, potensi kombinasi antara jus Hylocereus polyrhizus dan Serbuk Daun Kelor terhadap kadar Hemoglobin pada Remaja Putri masih belum diketahui. Tujuan penelitian ini adalah untuk mengetahui pengaruh pemberian campuran sari buah Hylocereus polyrhizus dan serbuk daun kelor terhadap kadar hemoglobin pada remaja putri. Penelitian Quasy Experimental dilakukan dalam penelitian ini dengan dua kelompok intervensi dan satu kelompok kontrol. Teknik purposive sampling digunakan untuk memilih 60 siswa khususnya remaja putri SMA Negeri 3 Kota Bengkulu pada bulan Mei 2022. Analisis statistik menggunakan uji One Way Anova dan Bonferonni Post Hoc test. Campuran jus Hylocereus polyrhizus dan

serbuk daun kelor berhubungan bermakna dengan peningkatan kadar hemoglobin dibandingkan kelompok yang hanya diberi jus *Hylocereus polyrhizus* dengan nilai $p = 0,000$ ($p < 0,05$).

Kata Kunci: Anemia, hemoglobin, daun kelor, jus buah naga merah

Introduction

The impact of nutritional anemia on adolescents is decreased concentration in learning and low learning achievement, besides that it will continue to become anemic pregnant women who are at risk of chronic lack of energy which will give birth to children with low birth weight and stunting (Kemenkes RI, 2022).

Data collected by Unicef in 2019 reported that 32% of adolescents aged 10-14 years and 48% of adolescents aged 15-19 years have anemia (UNICEF, 2020). One of the most common types of anemia in adolescents is Iron Deficiency Anemia (IDA), the prevalence of IDA cases in adolescents in Bengkulu City was 43% (Suryani et al., 2017).

A lack of intake of iron nutrients will cause iron deficiency in the body. Iron deficiency in the human body can be caused due to low iron intake, non-optimal iron absorption in the digestive tract and blood loss. In developing countries, general iron deficiency is caused by low iron intake or blood loss due to intestinal worm colonization (Besarab, 2018). Decreased iron intake can reduce hemoglobin levels in the body because iron is the main element forming hemoglobin. The average value of hemoglobin levels in women is 12-16 g/dl (Nasruddin et al., 2021)

Adolescent girls are prone to anemia because they are in their infancy and have menstruation every month, which causes iron loss (Sulistiyan et al., 2018). Therefore, nutrition improvement, in particular, has a meaningful impact, especially for young girls who will later become mothers. Considering that adolescents are still growing, low nutritional quality will make this growth hampered, and not achieving optimal intellectual abilities and physical growth will lead to malnutrition conditions passed on to the next generation (UNICEF, 2020).

Hemoglobin levels can be increased by eating foods containing micronutrients that support hemoglobin formation. To form hemoglobin, the body requires iron as the main constituent component. Iron obtained from food

is available in two forms, heme iron and non-heme iron.

The bioavailability of heme iron is higher (15-35%) than non-heme iron (2-2%), and its absorption is strongly influenced by the presence of other food components (Abbaspour et al., 2011).

Hylocereus polyrhizus (Red dragon fruit) is rich in nutrients and antioxidants. Sources of bioactive compounds in *Hylocereus polyrhizus* can have a positive impact on health (Urün et al., 2022). Lycopene in red dragon fruit has anti-anemic effects through upregulating erythropoiesis which is associated with the maturation factor (Eze et al., 2019). There are micronutrients in red dragon fruit, such as iron (3,40 mg), zinc (13,87 mg) and copper (0,03 mg). The iron content in *Hylocereus polyrhizus* was higher than local fruit such as; guava, papaya and pineapple. The present study found the amount of vitamin C in red pitaya juice (24,66 g/100 g - 30,21 g/100 g in RPM and RPA, respectively) (Nurul & Asmah, 2014).

Eighteen amino acids were found in red dragon fruit, and eight were essential amino acids (Arivalagan et al., 2021). Therefore, *Hylocereus polyrhizus* is a good source of essential amino acids; phenylalanine is the most common type of essential amino acid found in red dragon fruit, which is 183 mg/g (Wu et al., 2020). In addition, there are 7 components of phenolic compounds, which are antioxidants and the mostly found, namely Quercetin 3.43 mg/100 g in red-fleshed pitaya (Urün et al., 2022).

In addition, *H. polyrhizus simplicia* obtained from moringa leaves can be used as a therapy to prevent and control anemia. Moringa leaves are rich in protein. The protein is from raw moringa leaf flour (25,91 g/100g) (Milla et al., 2022). The protein content in moringa leaf is much higher than in potatoes, and pumpkin and the same as in milk, eggs and meat. Moringa leaf contains more vitamin A than carrots and more vitamin C than oranges. Total carotenoid content 1.10 mg -carotene, vitamin B1 326 g/100 g (González-Burgos et al., 2021) and vitamin C 220 mg/100 g (Gopalakrishnan et al., 2016). There

were 18 types of amino acids contained in *M.oleifera* and glutamic acid was the most found (30106,87 ppm) (Natsir et al., 2019).

Based on the explanation, this study investigated the effect of mixed *Hylocereus polyrhizus* juice and moringa leaf powder on hemoglobin in high school students.

Methods

A quasi-experimental pre and post-test design were used in this study in order to analyze the effectiveness of giving a mixture of *Hylocereus polyrhizus* juice and moringa leaf powder on hemoglobin levels in high school student especially adolescent girls in Senior High School School 3 Bengkulu City in May 2022. This study divided three groups: two treatment groups and one negative control group. The first intervention was given in the form of 100 grams of *Hylocereus polyrhizus* juice and 4.2 grams of moringa leaf powder/flour with the addition of 100 ml of water for 14 days. Meanwhile, for the second intervention, 100 g of red dragon fruit juice was given with the addition of 100 ml of water, and for the negative control group, 50 grams of plain jelly was given. Each group will measure hemoglobin before and after the intervention (as seen in figure 1).

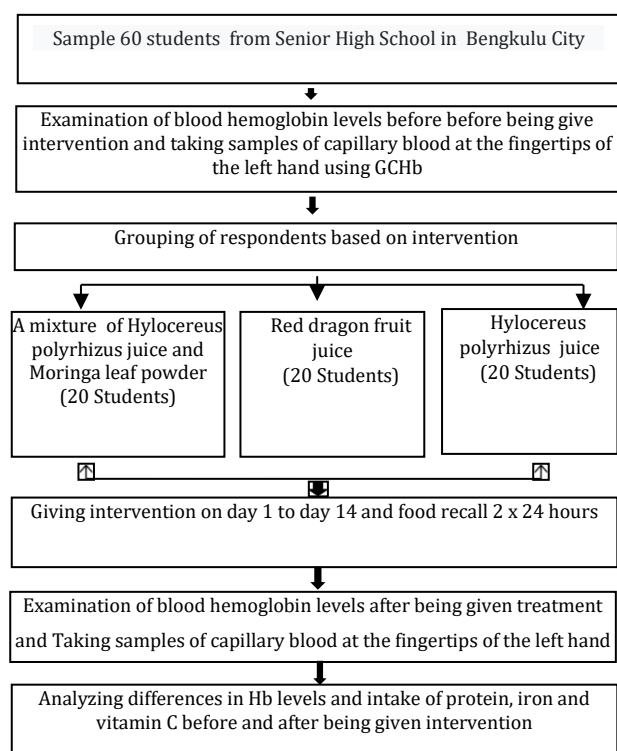


Figure 1. Flow Chart of Intervention

A purposive sampling technique was used to select 60 students from Senior High School 3 in Bengkulu City in May 2022. Respondents were determined according to predetermined inclusion criteria, namely aged 16-18 years, did not have any infectious diseases, did not take vitamin C and iron supplements, and did not have allergies to dragon fruit and moringa leaf. This research has been reviewed and approved by the Bengkulu Ministry of Health Poltekkes Ethics Commission with Number KEPK.M/096/03/2022.

Data Collection and Measure

The data collected includes the subject's characteristics, such as name and age, through a questionnaire. Furthermore, data on female adolescent hemoglobin levels were examined before and after the intervention using the GCHb tool.

Intervention

This study divided three groups: two intervention groups and one negative control group. The first intervention was given daily in the form of 100 grams of *Hylocereus polyrhizus* juice and 4,2 grams of moringa leaf powder/flour with the addition of 100 ml of water for 14 days. Meanwhile, for the second intervention, 100 g of *Hylocereus polyrhizus* juice was given with the addition of 100 ml of water, and for the negative control group, 50 grams of plain jelly was given.

Data Processing and Analysis

Microsoft excel and IBM SPSS 26,0 analyzed the data. The analysis was carried out by describing each variable in the study, including the characteristics of the respondents, hemoglobin levels and protein intake, vitamin C and iron before and after treatment. In this univariate analysis, paired t-test was used. Bivariate analysis was used to test whether there was a relationship between the independent and dependent variables.

The normality test was performed using the Kolmogorov-Smirnov test performed first. Homogeneity test with Lavene's test. Then if the data is usually distributed and homogeneous, it will be continued with the One Way Anova and Post Hoc Bonferonni tests.

Result and Discussion

Characteristics of subject

The characteristics of the respondents show that the age distribution of the respondents is in the age range of 16-17 years (Table 1).

Intervention group 1 was dominated by respondents aged 16 years, and the rest of the intervention group 2 respondents were 17 years old as a control group.

Effects of a Mixture Hylocereus Polyrhizus Juice and Moringa Leaf Powder on Hemoglobin Level

The results in table 2 showed that the differences in the average hemoglobin levels of adolescent girls who were given intervention 1

(a mixture of Hylocereus polyrhizus juice and moringa leaf powder) and treatment 2 (red dragon fruit juice).

In the treatment group 1, there was an average increase in hemoglobin levels of 2,2 g/dl, where the previous average hemoglobin level was 13,3 g/dl, and after being given a mixed of Hylocereus polyrhizus juice and moringa leaf powder for 14 days, it increased to 15,5 g/dl. Likewise, in the group that was given intervention 2 (Hylocereus polyrhizus juice), there was an increase in hemoglobin levels of 1,1 g/dl, whereas the average hemoglobin level before being given intervention was 13,1 g/dl and after 14 days of being given red dragon fruit juice there was an increase in Hb levels to 14,2 g/dl.

Table 1. The averages hemoglobin

Age	Intervention 1		Intervention 2		Control		p-value
	f	%	f	%	f	%	
16 years old	11	55	8	40	6	30	0,149
17 years old	9	45	12	60	14	70	

Table 2. The averages hemoglobin levels before and after giving intervention[#]

Variable	Intervention 1		Intervention 2		Control	
	Mean±SD	p-value	Mean±SD	p-value	Mean±SD	p-value
Haemoglobin						
Before	13,3±1,1		13,1±1,7		13,7±1,4	
After	15,5±1,0	0,000*	14,2±1,5	0,00*	13,2±1,3	0,001*
Mean difference	2,1±0,65		1,1±0,60		0,5±0,56	

[#]Paired t-test; *Significant at $p < 0,05$.

The statistical test results showed a significant difference in hemoglobin levels before and after intervention in the three groups ($p < 0,05$). In addition, the results of the statistical test showed that there was a difference in the increase in hemoglobin levels in the group that was given a mixture of Hylocereus polyrhizus juice with the addition of moringa leaf flour and the group that was only given red dragon fruit juice ($p < 0,05$). These results show that giving a mixture of Hylocereus polyrhizus juice with more moringa leaf powder for 14 days is more effective in raising hemoglobin levels than only red dragon fruit juice.

The result of this study is aligned with the reported research that has been done where the consumption of Hylocereus polyrhizus juice as much as 200 g for three days can increase hemoglobin levels from 10,7 g/dl to 11,4 g/dl (Wahyuningsih et al., 2021). In addition, research conducted by giving Hylocereus

polyrhizus juice can increase hemoglobin levels in anaemic adolescent girls from 8,92 g/dl to 13,14 g/dl (Usman & Kurnaesih, 2019)

Likewise, research examining the effect of moringa leaf on hemoglobin levels by giving moringa leaf flour supplements as much as 500 mg a day for 14 days can increase hemoglobin levels from 10,80 g/dl to 11,81 g/dl (Fitriyaa, 2020). In addition, nutrition education and administration of 2,100 mg of moringa leaf powder per day for 30 days can increase hemoglobin levels from 10,65 g/dl to 12,40 g/dl with an average gain of $1,76 \pm 0,80$ g/dl (Indriani et al., 2019).

Hylocereus polyrhizus and moringa leaf contain nutrients with non-nutrients that have the potential to increase hemoglobin levels. Based on this research, the combination of nutritional and non-nutritive substances derived from red dragon fruit and moringa leaf work

together to meet the nutrients needed to form hemoglobin. *Hylocereus polyrhizus* contains powerful nutrients and non-nutrients such as iron and vitamin C. Besides that, red dragon fruit also contains quercetin, amino acids and lycopene. In addition, Moringa leaf also contains other ingredients that increase hemoglobin levels in the blood, such as iron, vitamin A, vitamin C, amino acids, quercetin and glutamic acid.

The iron contained in red dragon fruit and moringa leaf powder is non-heme iron, where the stomach's acidic atmosphere strongly influences the absorption process. The content of vitamin C in dragon fruit and moringa leaf powder greatly helps the absorption of non-heme iron because vitamin C is a strong promoter of Fe absorption from food and can inhibit the absorption of phytate and tannins. Vitamin C works synergistically with Fe by increasing the absorption of Fe because the presence of vitamin C will convert Fe in a complex form into a more straightforward form so that it is more easily absorbed (Swamilaksita et al., 2022). Vitamin C works by changing the form of Fe³⁺ to Fe²⁺, causing iron to be absorbed more easily by the body four times faster than without vitamin C (Rahmawati et al., 2019).

The antioxidant content of flavonoids such as high quercetin in *hylocereus polyrhizus* and moringa leaf also increases hemoglobin levels. Flavonoids can potentially increase red blood cell (RBCs) production by stimulating the secretion of erythropoietin when it is very easily exposed to oxygen, and its membrane layer has a high concentration of essential fatty acids, making it easily exposed to oxidative stress. Red blood cells can also bind polyphenols to their surface, playing an important role in the distribution of polyphenols and protecting the erythrocyte membrane from oxidative damage. Quercetin in enterocytes acts as an electron donor and aids in the uptake of inorganic iron (Pasdar et al., 2020).

Table 3. The effectiveness of a mixture *hylocereus polyrhizus* juice and moringa leaf powder towards hemoglobin level

Variable	Mean Difference	p-value
Intervention 1 - 2	1,11	0,000*
Intervention 1 - Control	2,63	0,000*
Intervention 2 - Control	1,53	0,000*

#Post Hoc Bonferroni; *Significant at p<0,05.

There was a significant difference in the average gain in hemoglobin levels in each group, proved that a mixture of red dragon fruit juice and moringa leaf powder has the potential to increase hemoglobin levels compared to *H. polyrhizus* juice alone because of the nutritional content and other bioactive compounds present. As a result, the body gets much more and reacts better to increased hemoglobin levels in the blood.

Conclusion

The result of the study concluded that increasing hemoglobin levels was more effective in the group that was given a mixture of *Hylocereus polyrhizus* juice and moringa leaf powder than the group that was only given red *Hylocereus polyrhizus* juice. Therefore, a mixture of *Hylocereus polyrhizus* juice and moringa leaf powder can be an alternative intervention to prevent and cure anemia in teenager girls.

However, it is necessary to do further studies with specific control of daily diet to ascertain whether the increase in haemoglobin level is also influenced by a diet containing high iron.

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