The Intake of Beta Vulgaris and Amaranthus Tricolor L. Juice on Increasing the Hemoglobin Level

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Abstract: The most common anemia in the world is the one as the result of iron deficiency in the body. One of the health problems that appears to be a disruption to female workers is the nutritional deficiency anemia. This problem has an impact on the death of mothers and children, as well as on low achievement and decreased work productivity, especially for women who have multiple roles. Anemia mostly occurs in women of childbearing age, which is about 30.2% of 1.62 billion people. This study aimed to determine the effectiveness of Beta Vulgaris juice and Amaranthus Tricolor L juice on increasing Hb levels. This type of research was a quasi-experiment study with a pre-test and post-test control group design. The study used a total sampling technique with a sample of 30 teachers that consumed the Beta Vulgaris juice and the Amaranthus Tricolor L juice for 14 days. The results showed that there are significant increased levels of Haemoglobin after the intake of Beta Vulgaris juice and the Amaranthus Tricolor L juice by 1.03 gr/dL and 1, 34gr/dL, respectively. Individuals are implored to consume either Beta Vulgaris juice or Amaranthus Tricolor L juice regularly to experience the benefit of intaking it on increasing the Hb levels.

1 INTRODUCTION

The most common anemia in the world is one as the result of iron deficiency in the body. Nutritional anemia caused by iron deficiency is still a nutritional problem in Indonesia. One of the health problems that appears to be a disruption to female workers is the nutritional deficiency anemia. This problem has an impact on the death of mothers and children, as well as on low achievement and decreased work productivity. Moreover, this could also happen among women who have multiple roles such as being professionals who spend most of their time working outside of the house and as housewives who have obligation to do chores at home (Wagirah, 2015). Anemia mostly occurs in women of childbearing age, about 30.2% from 1.62 billion people. There are around 4-5 billion people in the world with an iron deficiency or around 66-80 percent of the world's total population. Most specifically, in developing countries, about 370 million women have been detected to undergo iron deficiency anemia. The highest prevalence of iron deficiency anemia in developing countries is found in South Asia with 64% in total. At the same time, the prevalence of anemia in women is 47% in Southeast Asia alone (Fitri, 2016).

Based on the 2017 Indonesian Demographic and Health Survey, the prevalence of anemia among the ages of 13 - 18 in women was 23% in Indonesia. The prevalence of anemia in men was lower than women, which was 17% in men aged 13 - 18 years. In line with the 2016 Home Health Survey, the prevalence of anemia in adolescent girls aged 15 - 20 years was 57.1%. In Riau province, the prevalence of anemia was 25.1%, and 19.4% aged 15 - 24 years. Furthermore, the incidence of anemia in women was 18.1%, and men was 7% (Yuni, 2017). On the other hand, the incidence of anemia in North Sumatra province in 2015 reached 57.1%; in 2016, it was 54.5%, and in 2017 it increased to 58.2% (Dinkes Propsu, 2017). Based on the results of the Basic Health Survey (Riskesdas) 2018, it is noted that there is an increase of anemia in Indonesia in 2018 as much as 48.9%. The most prominent prevalence was in pregnant women aged 15 – 24

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years as much as 84.6%, aged 25 – 34 as much as 33.7%, aged 35 – 44 as much as 33.6%, and aged 45 – 54 as much as 24% (Kementerian Kesehatan RI, 2018).

One solution that can be implemented to fulfill the needs of iron for the body so that the level of Haemoglobin (Hb) in blood stays maintained is by consuming vegetables and fruits containing iron in high content. One of the iron sources that plays a role in the formation of the high Hb is in beets and red spinach. However, little is known about the effects of beets (Beta Vulgaris) and red spinach (Amaranthus Tricolor L.) that can increase Hb levels. One research conducted by Kavitha, et al. (2020), Pokharel, et al. (2019), and Al-Aboud (2018) suggested that there was positive effect of giving Beta Vulgaris juice on Hb levels (Kavitha and Denish, 2020; Pokharel and Sharmila, 2019; Al-aboud, 2018). In addition, research by Bahadoran, et al. (2017) and Mirmiran, et al. (2020) revealed that there was another beneficial effect of beets that is lowering blood pressure and diabetes. Apart from beets, another food source that can optimize iron levels in the body is red spinach. Research conducted by Yudhistira, et al. (2018), Muliani, et al. (2017), and Majelti, et al. (2017) showed that positive effect could be gained by giving Amaranthus Tricolor L juice to increase hemoglobin levels (Yudhistira, Affandi, and Nusantari, 2018; Muliani et al., 2017; Maljeti, Mapanawang and Korompis, 2017). Meanwhile, research by Pradana, et al. (2017) and Kumar, et al. (2019) stated that there was healthier effect of consuming red spinach, which was preventing diabetes and reducing LDL levels (Pradana, Pondawinata and Widyarini, 2017; Kumar et al., 2019).

Those previous researches have been done with several approaches. The research method used by Kavitha, et al. (2020) and Phokarel, et al. (2019) was a one-group pre-test post-test design that compared only one treatment group with the aiming to determine the effectiveness of giving beets on Hb levels (Kavitha and Denish, 2020; Pokharel and Sharmila, 2019). In comparison, Al-Aboud (2018) compared the effectiveness of beetroot juice to the hematological level, which are the levels of Hb, Ferritin, Transferrin, etc. (Al-aboud, 2018). Furthermore, a research by Bahadoran, et al. (2017) used a meta-analysis method which showed the effectiveness of beets on Hb levels and on decreasing blood pressure (Bahadoran et al., 2017). While Mirmiran, et al. (2020) used a literature study to see the effectiveness of beets on reducing blood pressure and diabetes (Mirmiran et al., 2020).

The research method used by Muliani, et al. (2017), and Majelti, et al. (2017) was a quasi-experiment with a pretest-posttest with one control group with treatment aiming to find the effectiveness of giving red spinach on Hb levels (Muliani et al., 2017; Maljeti, Mapanawang and Korompis, 2017). In contrast, Yudhistira, et al. (2018) combined red spinach with tomatoes to increase Hb levels (Yudhistira, Affandi and Nusantari, 2018). A research by Pradana, et al. (2017) compared the effectiveness of red spinach extract against LDL levels and histopathology (Pradana, Pondawinata and Widyarini, 2017). Whereas, Kumar, et al. (2019) used a literature study to see the effectiveness of red spinach on lowering blood sugar (Kumar, Abbas and Austo, 2010). These previous researches help us to notice the benefits of the processing of beets and red spinach for consumption.

Based on those previous studies and the problem mentioned about the anemia affecting people's productivity, this research aimed to determine the effectiveness of intaking the Beta Vulgaris juice and the Amaranthus Tricolor L juice on increasing Hb levels. Our research used a different approach from previous ones. We implemented the quasi-experiment method with the pre-test – post-test which was carried out to test two experimental groups. They consisted of one group that consumed the Beta Vulgaris juice and the other group consumed the Amaranthus Tricolor L juice. In the end, we could see the impact of both intake on increasing Hb levels.

2 METHOD

This research was conducted at the Sekolah Kejayaan Indonesia, Binjai Barat, Binjai City, North Sumatra. The research was conducted from December 9 - 23, 2019. This type of research used a quasi-experiment with a pre-test and post-test with control group design. This study used a total sampling technique, which was all the teachers in the school. So, the number of samples in this study was 30 teachers. The inclusive criteria for the samples was female aged 20 – 40 years old, active teacher at the school, and not on period or pregnancy. Conversely, the exclusive criteria was male teacher above 40 years old.

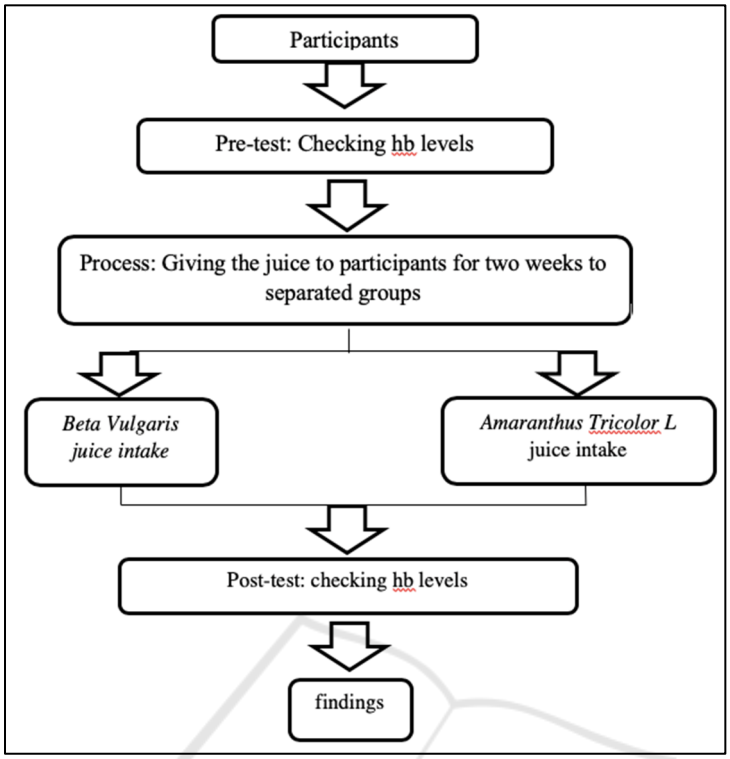

Figure 1: Research flow.

This research was conducted through several stages as follows:

1. Preparation phase.

   The researchers prepared facilities and infrastructure that would support research under the research permit and coordination with the school principal. The researchers defined the subjects of the research that happened to be the teachers in the school who were willing to be respondents in this study. Then, the researchers determined the schedule of meetings with respondents and provided them with instructions to follow. Then, the researchers hold face-to-face meetings with all respondents to present the flow of research activities that would be carried out for the next two weeks. The researchers also provided education related to research material. After that, the researcher distributed the respondent's consent statement to take part in the research activities carried out without coercion from any party. The researcher also gave instructions about things that should not be done during the research activity. Some things that should not be done by respondents were consuming food or drinks that contain tannins such as tea and coffee. This procedure was done because the tannin content in tea and coffee could interfere with the absorption of iron in the body so that it could cause the respondents' hb levels to appear low.

2. Implementation phase.

   This research was begun by checking the Hb level of the respondent before doing the research (pre-test) to determine the Hb level in each respondent before being given any special treatment. After obtaining the results of the hb levels of all respondents, the researchers immediately proceeded to the experiment stage by repeatedly giving red spinach and beet juice to respondents. The juice distribution was divided into two different groups of respondents. There was a group of respondents who was given beet juice, and a group of respondents who was assigned to intake red spinach juice within two weeks of giving. The intake was as much as 180 ml per day for two weeks. Then, to keep the respondents following these instructions, at the time of the research, the researcher distributed food recall to the respondents to find out what types of food or drink the respondents consumed during the

research. It was intended that researchers could monitor respondents' adherence to each research procedure. Besides, researchers continued to remind respondents of the importance of complying with each process of the study and improve closeness with respondents so that proper communication relationships were established. As a result, respondents could respond as expected by researchers. After the research time ended in two weeks, the researcher checked again the respondents' Hb level (post-test). Then, the researchers compared the results of the pre-test and the post-test of the respondents' Hb level.

The bivariate analysis used in this study was by using the Saphiro-Wilk test for normality test because the number of samples was less than 50 samples. After that, researchers would use the dependent t-test if the data were normally distributed and the Wilcoxon test if the data were not normally distributed to determine the effectiveness of increasing Hb levels between beet juice and red spinach juice.

The independent t-test would be used if the data were normally distributed and the Mann-Whitney test would be used if the data were not distributed normally; in order to know the difference in elevated Hb levels between the Beta Vulgaris juice and the Amaranthus Tricolor L juice at the significance level $\alpha = 0.05$ (Hulu and Sinaga, 2019).

3 RESULTS AND DISCUSSION

Table 1: Characteristics of Respondents.

No	Characteristics	Total	Percentage (100%)
1	Age		
	20 – 25 26 – 30 31 – 35 36 – 40	7 8 9 6	23.3 26.7 30 20
	Total	30	100
2	Anemia status		
	Anemia No anemia	23 7	76.7 23.3
	Total	30	100

Based on the characteristics of the respondents on Table 1, most the respondents' age was 31 - 35 years as many as nine people (30%). On the other hand, the minorities aged 36 – 40 years were six people (20%). Most respondents with anemia status were 23 people (76.7%) and the minority of seven people did not have anemia (23.3%).

Table 2: Pre-test and post-test of juice intake (gr/dL).

Amaranthus Tricolor L Juice		
Respondents	Pre-Test	Post-Test
1	12.6	11
2	8.4	10.4
3	9	11.4
4	10	11
5	9.4	10
6	11.2	17
7	11.4	13.8
8	13	12
9	9.6	12.2
10	14	12
11	10	10.3
12	11	11.2
13	10.4	15.3
14	10	12.1
15	12.4	12.8
Beta Vulgaris Juice		
Respondents	Pre-Test	Post-Test
1	11.4	10.1
2	10.9	11.3
3	10.2	10.8
4	11	12.5
5	9.8	9.5
6	9	10.2
7	13	18
8	10.9	10
9	14	13.9
10	8.8	12
11	9.9	10.5
12	9	12
13	13.6	14
14	10.8	14
15	11	10

Table 3: Effectiveness of Increasing Hb Levels through Beta Vulgaris Juice to Teachers.

Results of Hb Levels of Beta Vulgaris Juice	N	Mean	SD	Min – Max	Normality	p-value
Pre-test Hb levels	15	10,887	1,602	8,8 – 14	0,212	0,046
Post-test Hb levels	15	11,920	2,284	9,5 – 18		

Table 4: Effectiveness of Increasing Hb Levels through Amaranthus Tricolor L. Juice to Teachers.

Results of Hb Levels of *Amaranthus Tricolor L*	N	Mean	SD	Min – Max	Normality	p-value
Pre-test Hb levels	15	10,827	1,602	8,4 – 14	0,592	0,032
Post-test Hb levels	15	12,167	1,925	10 - 17		

Table 5: The difference of the effectiveness of Increasing Hb Levels between Amaranthus Tricolor L. Juice and Beta Vulgaris juice for teachers.

Hb levels	N	Mean	Homogeneity	p-value
Hb levels of Beta Vulgaris juice	15	11,920		0,715
Hb levels of Amaranthus Tricolor L. juice	15	12,167	0,477	

The results of the bivariate analysis on Beta Vulgaris juice, Table 3, show that the average pre-test Hb level was 10.887 gr / dL with a standard deviation of 1.602. The average post-test Hb level was 11,920 gr / dL, with a standard deviation of 2,284. The average Hb level after being given Beta Vulgaris juice increased by 1.033 gr / dL. Before the paired t-test was performed, researchers conducted a normality test in which to find out the data that were normally distributed. It resulted that the data of 15 respondents of the Beta Vulgaris juice group were normally distributed due to 0.2118 > 0.05. The results of the bivariate analysis using paired t-test obtained p-value = 0.046, which means that Ho was rejected. This result showed that there was a positive effect of increasing Hb levels through the intake of Beta Vulgaris juice.

Based on Table 4, the average pre-test Hb level is 10.827 gr / dL with a standard deviation of 1.602. The average post-test Hb level is 12.167 gr / dL with a standard deviation of 1.925. The average Hb level after being given Amaranthus Tricolor L juice increased by 1,340 gr / dL. This shows an increase in the value of the standard deviation between the pretest and posttest from 1.602 to 1.925, meaning that the greater the standard deviation value of a data, the greater the data distribution of each average value of the respondents' Hb level. The results of the bivariate analysis using paired t-test was p-value = 0.032, which means that Ho was rejected. This showed that there was a statistically significant effect (p value < 0.05), which brings to remark that there was a beneficial effect of increasing Hb levels through the administration of Amaranthus Tricolor L juice to the teachers.

The results of the bivariate analysis using unpaired t-test obtained p-value = 0.715 (Table 5), which means that Ho was accepted. This showed that it was not statistically significant effect (p value > 0.05), meaning that there was no difference in the effectiveness of increasing Hb levels through the provision of Beta Vulgaris juice and Amaranthus Tricolor L juice to teachers.

The results of this study are in line with the study of Kavitha & Denish (2020) with the same topic about the effect of beetroot juice on Hemoglobin among girls of selected hostel girls with the approach of experimental design. The research involved 30 respondents, and the intervention was run for 20 days. The study concluded that there was a statistically significant difference (p-value < 0.05) which indicated that there was a positive impact on beet juice administration to increase Hb levels; the average Hb level grew from 8.8 gr / dL to 11.17 gr / dL (Kavitha and Denish, 2020). The findings of this study are also consistent with Al-aboud 's study (2018), with the research title being Impact of Red

Beetroot (Beta vulgaris L.) Intake at the Level of Certain Hematological Tests in a Group of Female Volunteers.

The study concluded that variations in beet efficacy were observed at Hb levels, namely the average Hb levels increased from 11.9 gr / dL to 12.6 gr / dL (Al-aboud, 2018). Furthermore, the results of this study are in line with the research of Stephana et al. (2017) entitled Effectiveness of Beetroot Juice Giving Against Hemoglobin Levels of Pregnant Women with Anemia in Pekanbaru City Health Center in 2017. There was effectiveness in giving beetroot juice to increase hemoglobin levels of 34 people in Pekanbaru City Health Center, using the quasi-experimental approach with p-value = <0.001 (p-value <α). It means that there was positive efefct in giving beet juice to increase the Hb levels (Stephana, Utami and Elita, 2017).

According to the researchers' assumptions, one of the factors that cause anemia is meal or food selection. The components of nutrients that play a role in the formation of hemoglobin in food include iron and protein. A variety of food consumption patterns, such as types of food and the frequency of food consumed, can affect the value of a person's Hb level. Beets (Beta Vulgaris) are rich in B vitamins, and one of its main ingredients is folic acid. Folic acid itself serves to help the formation of red blood cells in the body so that if you regularly consume beets then you will increase the supply of red blood cells that are rich in oxygen throughout the body to prevent anemia. The body does not produce vitamin B, so to meet the need for vitamin B, it is essential to pay attention to the intake of foods that contain lots of vitamin B such as beets (Beta Vulgaris) (Proverawati and Asfuah, 2015).

The result of the bivariate analysis on Amaranthus Tricolor L juice was that the average pre-test Hb level was 10.827 gr / dL with a standard deviation of 1.602. The average post-test Hb level was 12,167 gr / dL, with a standard deviation of 1,925. The average Hb level after being given Amaranthus Tricolor L juice increased by 1,340 gr / dL. It can be seen that the data of the 15 respondents of the Amaranthus Tricolor L juice group were normally distributed due to 0.5922 > 0.05. The results of the bivariate analysis using the paired T-test obtained p-value = 0.0321 (p-value <0.05), which means that Ho was rejected. This result proved the effectiveness of increasing Hb levels through the intake of Amaranthus Tricolor L. juice.

The findings of this study also agree with the report made by Muliani, et al . (2017) titled Impact of Consuming Red Spinach (Amaranthus Tricolor L) Extract on Hemoglobin Levels In Postpartum Mothers. This study involved 30 respondents with the provision of intervention for 14 days. The result in this analysis was that the intake of red spinach has had a statistically important effect (p-value = 0.047 < 0.05). This means that red spinach juice was given effectively at Hb levels; the average Hb level increased by 1.25 gr / dL (Muliani et al., 2017). The results of this study are following the research of Majelti et al. (2017) that there is good effect of giving red spinach to increase Hb levels (p-value <0.05), where Hb levels increased from 7.1 gr / dL to 9.6 gr / dL (Maljeti, Mapanawang and Korompis, 2017). The results of this study are also consistent with those conducted by Meylawati, et al. (2018). It showed there was positive effect of spinach juice administration on Hb levels with p-value = < 0.001; with an average Hb level before getting intervention was 9.45 gr / dL and the average Hb level after intervention increased to 10.41 gr / dL (Meylawati, Nursanti and Widakdo, 2018).

According to the researchers, the previous study results are reinforced by Juliarti's statement in 2017, which stated that iron absorption is more efficient and effective if it is in the form of ferro since it dissolves quickly. For that, we need an acidic atmosphere in the stomach and a compound that can convert Feri into ferrous in the intestine, the compound in question is ascorbic acid (vitamin C). Apart from high iron content, there are other substances in red spinach that play a role in the formation of hemoglobin (Juliarti, 2017). Folic acid and vitamin B12 are essential ingredients in the formation of cell nuclei. Vitamin B6 and amino acids and lysine in red spinach play a role in the initial reaction of heme formation. Also, vitamins B6 and B12 are required in the process of synthesizing globin (Dondi, Rian and Putri, 2019).

The results of the homogeneity test showed a value of 0.477 < 0.05, so that it can be said that the data has the same variance. Therefore, researchers used unpaired T-test. The unpaired t-test has been granted a p-value of 0.715, so it can be inferred that Ho has been approved, and Ha has been denied. It means there is no difference in the efficacy of the consumption of Beta Vulgaris juice and Amaranthus Tricolor L. juice to increase the Hb levels. The assumptions of the researchers that the results could be due to the increase in Hb levels between the two

juices were not much different; the difference in average Hb level was 0.247 gr / dL. Women workers without anemia will be more productive at work than women with anemia. Therefore, women need food intake that contains iron in high levels, such as beets (Beta Vulgaris) and red spinach (Amaranthus Tricolor L), which are very helpful in the process of forming red blood cells in the body that can prevent anemia. If it is based on the average difference between Beta Vulgaris juice and Amaranthus Tricolor L juice, which are 1.033 gr / dL and 1,340 gr / dL, then Amaranthus Tricolor L juice is more effective to increase Hb levels.

According to the researchers, working women without anemia will be more productive at work than women with anemia. Therefore, women desperately need meals that contain high levels of iron, such as beets (Beta Vulgaris) and red spinach (Amaranthus Tricolor L) which are very helpful in the process of forming red blood cells in the body which eventually can prevent anemia. If we look at the average difference between Beta Vulgaris juice and Amaranthus Tricolor L juice, which is 1.033 gr / dL and 1,340 gr / dL, then Amaranthus Tricolor L juice is more effective in increasing Hb levels in teachers at the school. In this study, the researchers applied the same method to the two types of juices, both in the processing, the types of additives used to the dosage of each type of food used. The difference was the price aspect of the raw materials for this study, namely red spinach and beets. On the market, the price of red spinach is cheaper than beets. For this reason, red spinach is more efficient for consumption from an economical point of view. Moreover, red spinach tastes better than beetroot.

4 CONCLUSIONS

Based on the results of the research on the effectiveness of increasing Hb levels through the intake of Beta Vulgaris juice and Amaranthus Tricolor L juice, we can conclude that there is the effectiveness of increasing Hb levels through the consumption of Beta Vulgaris juice and Amaranthus Tricolor L juice. The increase was of 1.033 gr / dL (p-value = 0.046) and 1,340 gr / dL (p-value = 0.032) respectively. However, there is no difference in the effectiveness of increasing Hb levels through the intake of Beta Vulgaris juice and Amaranthus Tricolor L juice (p-value = 0.715). Researches implore individuals to consume either Beta Vulgaris juice or Amaranthus Tricolor L juice regularly to experience the benefit of intaking it on increasing the Hb levels.

It is important for teachers to pay more attention to good nutritional intake for the body, especially nutrition that can increase Hb levels such as beets (Beta Vulgaris) and red spinach (Amaranthus Tricolor L). Given that these two ingredients are very easy to find in the market. Apart from being beneficial for body health (increasing the body's immune system), paying attention to nutritional intake will also affect better performance and increase the productivity of respondents during work and while doing various daily activities.

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