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Original Research

Tamarillo Juice (Solanum betaceum Cav) as An Alternative to Increase Hemoglobin Levels for Pregnant Women with Anemia

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Abstract

Introduction: World Health Organizations recommends pregnant women to consume 120-240 mg of iron (in the form of Ferrum) per day and increase the dose by 400 mg 3 times a day if the Anemia is severe. One of the herbal therapies that can increase hemoglobin levels is Tamarillo (Solanum Betacum Cav) with a vitamin C level of 25 mg, Fe 2,765 ppm. The research objective was to analyze the effect of Tamarillo juice consumption in increasing hemoglobin (HB) levels of pregnant women with Anemia.
Methods: Quasi-experimental research with pre and post-test along with control group design was used to compare the HB levels of ≥ 32 weeks pregnant women who were given Tamarillo fruit juice. Subjects in this study were 34 pregnant women as the treatment group who received Tamarillo juice and blood supplement and the control group of pregnant women who only receive blood supplements.
Results: The results of the T-test analysis showed that in the treatment group there was an increase in the average hemoglobin level of 0.91 g/dL in the first week and 1.75 g/dL in the second week, while in the control group there was an increase in the average hemoglobin level of 0.43 g/dL in the first week and an increase of 0.89 g/dL in the second week.
Conclusion: The administration of Tamarillo juice as an alternative companion to blood supplement in the prevention and management of care for pregnant women with Anemia.

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INTRODUCTION

The fundamental right of humans is the right to live, but in the reality, there are around 830 mothers in the world and around 38 mothers in Indonesia (Data SUPAS 2015 Maternal Mortality Rate or MMR 305 / 100,000 live births) who lost their lives every day due to complications related to pregnancy and childbirth. Most of these passing mothers could have been largely prevented and they could have been saved with the right prevention. The estimation of high-risk pregnant women in Indonesia is 15%, the other 85% is normal, while in North Tapanuli the estimated high-risk is higher than the national rate, which is 20% [1]. Around 75% of this maternal death is due to bleeding, infection, and high blood pressure during pregnancy (preeclampsia/eclampsia), prolonged labor/congestion and unsafe abortion [2]. Anemia is the leading cause of maternal death due to postpartum hemorrhage.

The pregnant women group is a group with a high risk of experiencing Anemia. In Indonesia, almost half of the pregnant women (48.9%) suffer from Anemia [2]. This data has a higher number when compared to the result in 2013. In 2013, there are 37.1% of pregnant women suffer from Anemia, with a proportion of (37.8%) in rural areas. It is higher than urban with (36.4%) [3]. Anemia is defined as having less than 12 g/dL of hemoglobin concentration in nonpregnant women and less than 10 g/dL in pregnant women during their pregnancy or the puerperium. Anemia in pregnant women who receive blood supplement with hemoglobin concentrations of 5-11 g/dL in the first and third trimesters, and 10.5 g/dL in the second trimester. Anemia can affect pregnancy (abortion, antepartum bleeding, premature delivery, stunted fetal growth), labor (postpartum hemorrhage), childbirth (lactation, puerperal infection, increased incidence of venous thrombosis) fetus, and neonate (fetal growth, stunted womb, fetal death in utero, premature birth, asphyxia, and perinatal death). One that can contribute to the treatment of Anemia is iron administration [4].

WHO recommends pregnant women to consume 120-240 mg of iron (in the form of Ferrum) per day and 500 g of folic acid per day. Avoid number 200 mg of Ferrum sulfate is consumed (1 tablet per day starting from 16 weeks of gestation, the dose is increased by 400 mg 3 times a day if Anemia is severe [4]. In Indonesia, there are 73.2% of pregnant women consume blood supplements and 26.8% of them do not. From those who received the blood added tablet, 76% received less than 90 tablets, and 61.9% consumed them, while those who received more than 90 tablets are as much as 24% and 38% are consumed. Based on data from the 2017 Indonesian Health Profile [5], the coverage of blood supplements administration in Indonesia and North Sumatra is still below the 2017 Strategic Plan target (90%). Coverage of blood supplements administrations in Indonesia is 80.18%, in the North Sumatra Province is 78.02% while in North Tapanuli the coverage of blood supplements administration is 73.3% [1]. Only 10-30% of the orally consumed iron in the form of iron sulfide can be absorbed by mucosa.

The government management in dealing with Anemia in pregnancy is still curative and preventive, which only aims to prevent complications during pregnancy. The pharmacological therapy provided is iron equivalent to 60 mg of elemental iron (in the form of ferrous sulfate, ferro fumarate or ferro gluconate) and 0.400 mg of folic acid [6].

Non-pharmacological therapies that have been widely used to deal with Anemia in pregnancy include consuming red guava [7], papaya fruit [8], and consuming long bean leaves [9]. These studies have not provided the expected results, where the number of Anemia cases in pregnancy is still high. So further research related to Anemia in pregnancy is expected.

One of the herbal therapies that can increase hemoglobin levels is Tamarillo (Solanum Betacum Cav), which is still one species with eggplant (Solanaceae) [10]. Tamarillo lives in mountainous areas at an altitude of 500 to 1000 meters above sea level with a temperature of 20-27 degrees Celsius, so Tamarillo can grow in North Tapanuli Regency since approximately 40% of the area in North Tapanuli is at an altitude of 300 - 1000 meters above sea level. Farmers in the North Tapanuli district can harvest Tamarillo throughout the year. The market price of Tamarillo is IDR 10,000 to IDR 14,000 / kg, so it is affordable, and any mother can get it anytime. Tamarillo can be consumed as fresh fruit, as cooking spices, and vegetables. Tamarillo test result in the laboratory of the Center for Food Agriculture, Agricultural Technology Study Program shows that Tamarillo contains 588.079 ppm vitamin C and 2,765 ppm Fe nutrition in every 100 grams of Tamarillo [11]. The research objective was to analyze the effect of Tamarillo juice consumption in increasing hemoglobin (HB) levels of pregnant women with Anemia.

METHODS

This research is a quasi-experimental study using pre and post-test with control group design to compare HB levels of 32-40 weeks pregnant women who consume Tamarillo fruit juice. The subjects in this study were divided into two groups. The first group was the treatment group, namely pregnant women with Anemia at 32-40 weeks of gestation who consume Tamarillo juice and blood supplement tablets. The second group was the control group, 32-40 weeks pregnant women with Anemia who consume blood supplement tablets.

The sample of the study was pregnant women with Anemia at pregnancy age of 32–40 weeks. The sampling technique used is purposive sampling. The criteria of the sample include the HB levels of the participants are under <11 g%, and they are not under psychological stress. The research was conducted from July 2020 to September 2020 in 4 health centers in the North Tapanuli District Health Office, namely Siatas Barita Health Center, Hutabaginda Health Center, Sitada-tada Health Center, and Pangaribuan Health Center. The sample in this study was divided into two groups, namely the treatment group (pregnant women with Anemia at 32-40 weeks of gestation who consume Tamarillo (Solanum Betacum Cav) juice and blood supplement tablets for 14

days). The second group is the control group (pregnant women with age Anemia. 32-40 weeks of pregnancy) who do not consume Tamarillo (Solanum Betacum Cav) juice and only consume blood supplement tablets). The number of samples for each group was 17 pregnant women, so the total sample was 34 mothers.

Before performing in the two groups, the study subjects' data were assessed based on questionnaires and HB measurement, then both groups were given intervention with Tamarillo (Solanum Betacum cav) juice for 14 days, or a control group without Tamarillo juice (Solanum Betacum cav) and only given blood supplement tablet. The measurement of hemoglobin was taken three times consisting of the first day, 7th day, and 14th day. The data analysis used was the T-Test [12].

Ethical clearance was obtained from the Poltekkes Kemenkes Medan Research Ethics Committee (No: 01.1103/KEPK/2020). Informed consent was obtained from the participants before the start of the interview sessions.

RESULTS

Respondent Characteristics

The results of this study showed that on average 1 of 2 pregnant women whose hemoglobin levels were measured had Anemia (96 respondents examined pregnant women) and 41 respondents (43%) had Anemia.

The characteristics of respondents consist of age, gestational age, parity, education, and occupation. The data was obtained through a questionnaire. Table 1 shows the results of the analysis of the characteristics of the respondents based on the age of pregnant women in the intervention group, it was found that the average age of the mothers was 30.18 years and in the control group, the average age of the mothers was 30.94 years. The results of the homogeneity test between the intervention group and the control group showed homogeneous data variants or the same equivalence test ($p = 0.280$).

Table 1 shows the result analysis of the respondents' characteristics based on gestational age in the intervention group. The data shows that the mothers' average gestational age was 32.88, and the average gestational age of the mothers in the control group was 32.71. The results of the homogeneity test between the intervention group and the control group showed homogeneous data variants or the same equivalence test of ($p = 0.305$).

Table 1 shows the result analysis of respondents' characteristics based on parity in the intervention group. Most of the respondents had multigravida parity, with 11 respondents (64.7%), and 6 primigravida (35.3%). Whereas in the control group, 3 respondents (17.6%) had multigravida parity and 14 respondents (82.4%) had primigravida parity. The results of the chi-square test showed that the two groups had a homogeneous or equivalent variant. There was no significant difference in the respondents' parity between the intervention and control groups with a p-value of 0.005.

The results analysis of the education level shows that respondents in the intervention group were mostly from

secondary education level (64.7%). The education level of the control group, the majority is from secondary education level (76.4%). It averages that the respondents' parity between the intervention and control groups with a p-value of 0.507.

The results analysis of the mothers' occupation showed that respondents in the intervention group were mostly housewives who do not work (41.2%), in the control group the majority of mothers were farmers (41.2%) with a p-value of 0.730.

The chi-square statistical test showed that the mothers' age, gestational age, education, and occupation were not different/homogeneous (p> 0.05), only maternal gravidity was different between the two study groups because each study location had different gravidities. These characteristic conditions can conclude that the respondents are homogeneous.

Data Normality Test

The data normality test was performed before the bivariate test in the intervention group and the control group to determine the data analysis test to be used. The data normality test in this study used the Shapiro-Wilk Test (sample <50).

In conclusion, the results of the Shapiro-Wilk analysis of hemoglobin distribution variable in the intervention group and the HB first, second, and third control groups obtained a p-value ≥ of 0.05. It averages that the data is distributed normally so that the parametric analysis test was carried out using the T-test.

Analysis of Differences in Hemoglobin Levels Before and After Treatment in the Intervention Group and the Control Group Hb Levels Test I, II, III

Based on table 3, it can be seen that before the intervention was given in the intervention group (HB Level Test I) the average hemoglobin was 10.70 g/dL with a standard deviation of 0.581. After the first week of Intervention (HB Level Test II), there was an increase in the hemoglobin average of 11.61 g/dL with a deviation standard of 0.507. After the second week of Intervention (HB Level Test III), there was an increase in the hemoglobin average of 12.45 g/dL with a deviation standard of 0.442. In the Control group before the intervention was given (HB Level Test I) the hemoglobin average was 11.12 g/dL with a standard deviation of 0.538. After the first of intervention (HB Level Test II) an increase in the hemoglobin average was 11.55 g/dL with a deviation standard of 0.659, and after giving the second week of Intervention (HB Level Test III) there was an increase in the hemoglobin average of 12.01 g/dL with a deviation standard of 0.504.

The results of this study stated that in the intervention group there was an increase in average hemoglobin level of 0.91 g/dL in the first week and an increase of 1.75 g/dL in the second week. While in the Control group there was an increase in the average hemoglobin level of 0.43. g/dL in the first week and an increase in the average hemoglobin level of 0.89 g/dL in the second week. It averages that the increase of average hemoglobin level in the Intervention group was higher than in the

Control group. After the data analysis test was carried out using the t-test (α 0.05), a p-value ≥ of 0.011 was obtained, which average s that there was an effect of giving Tamarillo fruit juice in increasing hemoglobin (HB) levels in mothers with Anemia.

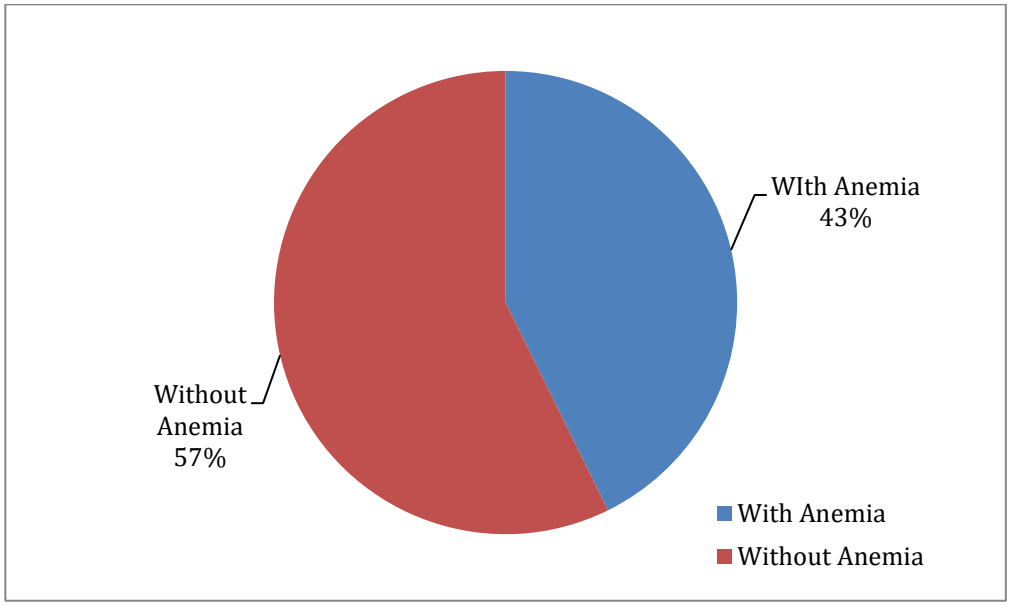

Fig. 1. Respondents of Third Trimester Pregnant Women who were tested for hemoglobin

Table 1
Distribution of Respondent Characteristics by Age, Gestational Age, Parity, Education, Occupation

Characteristic	Group				p value[a]	p value[b]
	Intervention		Control			
	n=17	%	n=17	%		
Mothers' age					0,280	
a. Average ±SD	30,18±5,38		30,94±3,96			
b. Minimum-Maximum	20-37		23-37			
Gestational age					0,305	
a. Average ±SD	32,88±1,83		32,71±1,21			
b. Minimum-Maximum	32-37		32-36			
Gravida						0,005*
a. Primigravida	6	35,3%	14	82,4%		
b. Multigravida	11	64,7%	3	17,6%		
Education Level						0,507*
a. High (College)	4	23,5%	2	11,8%		
b. Sedentary (High School)	11	64,7%	13	76,4%		
c. Low (Elementary)	2	11,8%	2	11,8%		
Occupation						0,730*
a. Government Employees	3	17,6%	4	23,5%		
b. Farmers	5	29,4%	7	41,2%		
c. Weaving	2	11,8%	2	11,8%		
d. Housewives	7	41.2%	4	23,5%		

[a] *Independent t-test,* [b]*Chi square*
**Level significancy >0,05*

Table 2
Data Normality Test (Shapiro-Wilk) On Intervention and Control Groups

Hb Test	Groups	Shapiro-Wilk		
		Statistic	df	Sig.
I	Intervention	.966	17	.738
	Control	.924	17	.171
II	Intervention	.970	17	.812
	Control	.967	17	.766
III	Intervention	.905	17	.084
	Control	.965	17	.727

Table 3
Analysis of Differences in Hemoglobin Levels Before and After Treatment in the Intervention Group and the Control Group Hb Levels Test I, II, III

Hemoglobin Levels	Group		*p value*
	Intervention (n=17)	Control (n=17)	
HB Level Test I Average HB Level ± SD	10,70 ± 0,581	11,12 ± 0,538	0,034
HB Level Test II Average HB Level ± SD	11,61 ± 0,507	11,55 ± 0,659	0,772
HB Level Test III Average HB Level ± SD	12,45 ± 0,442	12,01 ± 0,504	0,011

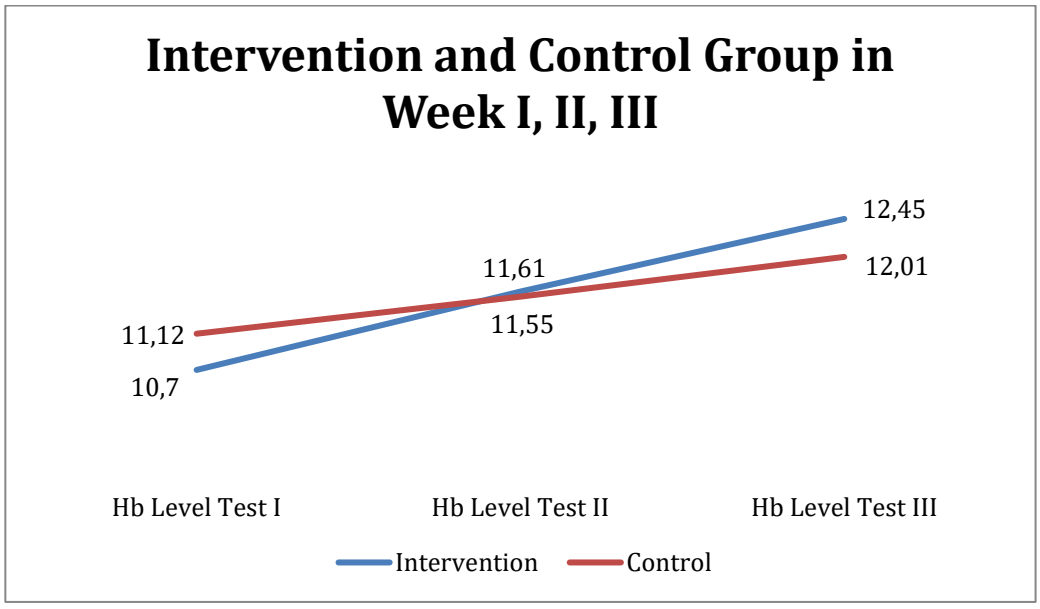

Fig. 2. Changes in Average Hemoglobin Test Levels in the Intervention and Control Group

DISCUSSION

The results of this study showed that on average 1 of 2 pregnant women whose hemoglobin levels were measured had Anemia. Amount 96 respondents of pregnant women were examined, and 41 respondents (43%) had Anemia. This figure is similar to the data from Kementerian Kesehatan Republik Indonesia (2019), almost half the proportion of pregnant women (48.9%) in Indonesia is Anemia [2]. And the results of this study shows that Anemia case is higher than WHO data in 2017 where the prevalence of Anemia in pregnant women worldwide is 41.8% [13].

The results of this study based on gestational age in the Intervention group obtained an average gestational age of 32.88 weeks and in the Control group, the average gestational age of the mother was 32.71 weeks.

Respondents' Characteristic

Age

The result analysis of the respondents' characteristic based on the gestational age of pregnant women with Anemia in the Intervention group showed that the average gestational age of pregnant women was 30.18 weeks, and in the Control group, the average gestational age of the mothers was 30.94 weeks. It is because most respondents in this study were between the ages of 20-35 years. The results of this study are different from the research conducted by Astriana (2017), the majority of Anemia pregnant women aged <20 years and> 35 years (71.8%) [14] and Melku, et al. (2014), the average age of pregnant women is 26-47 years [15].

Parity

The result based on parity showed that Anemia increased in the Intervention group with multigravida parity of (64.7%) and the control group in primigravida of (82.4%). The risk factor for Anemia is parity (grande multiparity). Since the body usually stores iron after pregnancy, but if pregnancy often occurs the body does not have enough time to produce it, besides that most of the mothers come from the low socio-economic class. Excessive iron needs, for example in mothers who often get pregnant or have multiple pregnancies. Likewise, the proportion of iron intake is directly related to calorie intake, the iron status will decrease along with a decrease in calorie intake and thus many pregnant women do not have sufficient iron stores to meet their needs during pregnancy, in particular if during childbirth there is a lot of blood loss. The population at risk for Anemia is mothers who have many children who are very close to birth [4]. The results of this study are in line with other research which states that pregnant women who have parity of more than 2 (two) suffer from Anemia more than those with a parity of less than 2 (two) and the difference is statistically significant $p \leq 0.001$ [16].

Education

The results of this study showed that pregnant women with secondary education levels are more likely to suffer from Anemia, namely the mothers in the intervention group

(64.7%) and the Control group (82.4%). Education has a significant effect on the occurrence of Anemia with p ≤ 0.001, the prevalence of Anemia is higher in mothers with low education, related to low levels of education [16].

Occupation

The results of this study indicate that pregnant women who suffer from Anemia increased in the intervention group for non-working mothers (41.2%) and in the control group for mothers whose jobs were farmers (41.2%). It is because mothers who work as domestic workers pay less attention to their health. After all, pregnant women spend time taking care of household needs. This shows a different result from Prawirohardjo that stated work or occupation is one of the possible factors for Anemia due to workload increase. Pregnant women can work but not too hard [17]. Work can lead to an increase in workload which affects pregnancy outcomes [18].

Changes in hemoglobin levels of anemic mothers due to Tamarillo juice and blood supplements administrations

The results of this study indicated that there was an increase in hemoglobin levels after the administration of Tamarillo and blood supplements. Based on the results of research conducted in the intervention group before the intervention provision (HB Level Test I), the average hemoglobin was 10.70 g/dL. After the first week of Intervention (HB Level Test II), there was an increase in the average levels of hemoglobin of 11.61 g/dL, and after giving the second week of Intervention (HB Level Test III) an increase in the average level of hemoglobin was 12.45 g/dL.

The amount of iron absorbed depends on several factors such as food containers, iron stored in the body, speed of red blood cell production, and compliance with iron drinking or not. An increase in hemoglobin level of 2 g/dL should be seen within 3 weeks after starting iron administration, and iron absorption is higher due to the addition of Tamarillo (*Solanun betacum cav*) juice. The increase in hemoglobin levels in the intervention group was due to the nutrients in Tamarillo *(Solanum betaceum Cav)* which could increase hemoglobin levels. Iron absorption increases if there is an acid in the stomach [19][20]. The presence of this acid can be increased by giving iron tablets with ascorbic acid (vitamin c) 200 mg or with Tamarillo juice [21][22]. Vitamin C is a water-soluble vitamin and rarely accumulates in the body [23]. The test results of Tamarillo in the laboratory of the Center for Food Agriculture, Agricultural Technology Study Program, contain 588.079 ppm vitamin C and 2,765 ppm Fe nutrition in every 100 grams of Tamarillo.

Tamarillo is a plant with complete nutritional content. It is especially rich in iron. This content is the main ingredient that increases hemoglobin levels because hemoglobin is a blood component that binds to iron (FE). In addition to the high iron content for the process of hemoglobin formation, Tamarillo is also rich in vitamin A [24] .

Tamarillo (Solanum Betacum Cav) has a high vitamin A content. Hemoglobin formation is strongly influenced by vitamin A. Vitamin A is very good to maintain the health of epithelial tissue including the endothelium in blood vessels, so along with the increase and adequacy of vitamin A will increase the value of hemoglobin [25].

Changes in hemoglobin levels in mothers with FE tablets administration

The results of this study show that before the control group was given intervention (HB Level Test I) the average hemoglobin was 11.12 g/dL with a standard deviation of 0.538, after the first week of Intervention (HB Level Test II) there was an increase in the average level of hemoglobin with 11.55 g/dL with a standard of 0.659, and after the second week of intervention (HB Level Test III) there was an increase the average level of hemoglobin of 12.01 g/dL with a standard of 0.504.

The results of this study are following the theory which states that an increase in hemoglobin levels of 2 g/dL should be seen within 3 weeks after starting iron administration. If there is no response to iron administration within 3 or 4 weeks, the iron administration should be reviewed. The iron that is swallowed orally is absorbed in the form of ferrous sulfide. Only 10-30% of the iron can be absorbed by the mucosa. blood supplements are more tolerable if they are taken before bed at night. Iron is a mineral needed by all biological systems in the body. Iron is stored in the liver, spleen, and bone marrow. About 70% of the iron in the human's body is in hemoglobin and 3% in myoglobin (intramuscular oxygen stores. The amount of iron that will be absorbed depends on some factors such as food containers, iron stores in the body, speed of red blood cell production, and whether pregnant women adhere to taking iron supplements or not [23].

According to Lopez (2015), Anemia treatment aims to provide sufficient iron to normalize hemoglobin concentrations and replenish iron stores to improve the life quality. There are 2 approaches to prevent Anemia, namely dietary-based active iron supplementation. It can be carried out by promoting and consuming foods rich in iron, such as meat, and vegetables such as nuts and green foods. The availability of iron can be increased with an absorption enhancer, namely ascorbic acid. Iron absorption inhibitors such as calcium, phytates in cereals, tannins are found in tea and coffee must be reduced. Tea can reduce iron absorption by up to 90% [26].

The Effect of Tamarillo Juice & FE Tablets on Changes in Hemoglobin Levels compared to FE Tablets in Women with Anemia

The result of the study shows that Tamarillo and blood supplement tablets administration has a higher potential to increase hemoglobin levels compared to FE administrations without Tamarillo juice. Based on table 3, it can be seen that before intervention in the intervention group (HB Level Test I) the average hemoglobin level was 10.70 g/dL with a standard deviation of 0.58. After the first week of Intervention (HB Level Test II),

there was an increase in average hemoglobin level of 11.61 g/dL with a standard of 0.507. And after the second week of intervention (HB Level Test III), there was an increase in the average hemoglobin level of 12.45 g/dL with a standard of 0.442. Before intervention in the control group, (HB Level Test I) the average hemoglobin level was 11.12 g/dL with a standard deviation of 0.538. After the first week of intervention (HB Level Test II), the average hemoglobin level increased to 11.55 g/dL with a standard deviation of 0.659, and after the second week of intervention (HB Level Test III) the average hemoglobin level increased to 12.01 g/dL with a standard deviation of 0.504.

The results of this study show an increase in hemoglobin levels in both groups. This is due to the administration of 60 mg Fe tablets and Tamarillo juice administration for the intervention group. Giving 60 mg Fe tablets per day can increase the hemoglobin level by as much as 1 g% / month [27]. Taylor (1992) in Myles (2009) reported that the average hemoglobin level in aterm pregnant women was 12.7 g/dL for those who received blood supplements and 11.2 g / for those who did not get blood supplements administration. Blood supplements with iron enhancers should be given if there are anemic mothers with 9-10 g/dL HB levels. The iron supplement given will be an adequate iron reserve for the mother needed for the mothers with labor with surgery or experiences post-partum bleeding and the mother will start her next pregnancy with better iron stores [28].

The results of this study are following the theory that iron absorption increases if there is an acid in the stomach. The presence of acid can be increased by consuming blood supplement tablets with 200 mg ascorbic acid (vitamin C) tablets or with orange juice. Vitamin C is a water-soluble vitamin and rarely accumulates in the body [23][29]. Dutch eggplant fruit has high water content, therefore this plant is very suitable for consumption in the form of juice [30].

The results of the study by Sulistianingsih et al., (2015) stated that the accuracy of consuming iron has a huge influence on Anemia. Blood supplement tablets should be taken at night because the absorption process will be faster than in the morning or during the day, at night the body's metabolic system will work twice as much. However, if the mothers consume food and drinks such as Coffee, Tea, Milk, which contain Tannins, Phytate, Oxalate, Calcium that can bind Iron before it is absorbed by the intestinal mucosa in the morning or during the day, it can indirectly inhibit the absorption of iron substances [31]. Tamarillo (Solanum betacum Cav) contains 12 mg of vitamin C in 100 grams of fresh Tamarillo [25][32][33].

The results of this study stated that there was an increase of average hemoglobin level in the intervention group of 0.91 g/dL in the first week and 1.75 g/dL in the second week, while the average hemoglobin level of the control group increased to 0.43. g/dL in the first week and 0.89 g/dL in the second week. This show that the increase of average hemoglobin level in the Intervention group was higher than in the control group.

The results of this study showed that after the data analysis test was carried out using the t-test (α 0.05), p ≥ 0.011 was obtained. It shows that there was an effect of Tamarillo (Solanum Betacum Cav) juice administration due to the increase in hemoglobin levels. The results of this study are supported by Sianturi et al. research in 2013 on the effect of Tamarillo (Solanum betacum cav) on the number of erythrocytes and hemoglobin levels of Anemia male mice through induction of sodium nitrite (NaNO2) with an optimal concentration of 60% (p <0.05) [24].

LIMITATIONS

The limitation in this study is that the researcher cannot fully control the external variables that can affect the results of the study, such as nutrition, knowledge, attitudes and behaviour, and dietary factors.

CONCLUSION

The intervention group was administered with Tamarillo juice (Solanum betacum cav) and iron tablets. An increase in hemoglobin levels in the Intervention group can be seen in the result. There was an increase in the average hemoglobin level of 0.91 g/dL in the first week and 1.75 g/dL in the second week. It is higher than the Control group who was only administered with iron tablets, the average hemoglobin level increased to 0.43 g/dL in the first week and 0.89 g/dL in the second week, with a p-value ≥ of 0.011. These results show that Tamarillo has the potential as a companion product or diet (substitute for Vitamin C) to increase hemoglobin levels in mothers with Anemia.

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