ORIGINAL RESEARCH

EFFECT OF CONSUMING GUAVA LEAVES (PSIDII FOLIUM) EXTRACT ON THE LEVEL OF BLOOD PROFILE IN TEENAGE GIRLS AT VOCATIONAL HIGH SCHOOL OF PALEBON SEMARANG, INDONESIA

Yulaeka[1*], Ari Suwondo[2], Titi Suherni[1], Suharyo Hadisaputro[3], M.Choirul Anwar[4]

[1]Midwifery Program, Magister Applied Midwifery, Politeknik Kesehatan Kementrian Kesehatan Semarang, Indonesia
[2]Faculty of Public Health, Diponegoro University, Semarang, Indonesia
[3]Faculty of Medicine, Diponegoro University, Semarang, Indonesia
[4]Program of Studi Imaging Diagnostic, Magister Applied Midwifery, Politeknik Kesehatan Kementrian Kesehatan Semarang, Indonesia

*Corresponding author:
Yulaeka
Magister Applied Midwifery, Politeknik Kesehatan Kementrian Kesehatan Semarang
Jl. Tirto Agung, Pedalangan, Banyumanik Kota Semarang, Jawa Tengah, Indonesia (50268)
E-mail: yuuchanyulaeka@gmail.com

ABSTRACT
Background: Women are at risk of iron-deficiency anemia, especially in teenage girls. One alternative treatment to prevent the occurrence of anemia is to consume guava leaf extract.
Objective: To examine the effect of guava leaves extract on changes in blood profile level in teenage girls.
Methods: This study was a quasi-experiment with pretest posttest control group design. This research was conducted at SMK Palebon Semarang Indonesia conducted on December 2016 - January 2017. There were 36 samples selected using a purposive sampling, with 18 samples were assigned in the experiment and control group. Blood profiles was measured in the Laboratory of Cito Klinik Setiabudi to see the hemoglobin level, hematocrit level, erythrocyte count, and platelet count. Data were analyzed using Independent t-test.
Results: There were significant differences in hemoglobin and thrombocytes levels after given intervention between the experiment and control group with p-value <0.05. However, the intervention has no effect on hematocrit and erythrocytes levels (p>0.05).
Conclusion: Guava leaves (Psidii folium) extracts have a significant effect on changes in hemoglobin and thrombocyte levels in teenage girls, but not in the hematocrit and thrombocytes levels. Therefore, it is suggested that guava leaves (Psidii folium) extracts can be an alternative treatment for midwives to prevent the occurrence of anemia in teenage girls.

Keywords: anemia, teenage girls, guava leaves extract

INTRODUCTION

Anemia is one of the health problems around the world, especially in developing countries that estimated 30% of the world population suffers from anemia.[1] Anemia mostly occurs in teenagers and pregnant women; and the rate of Anemia among adolescent girls is also considered high.[1]

According to data from Riskesdas,[2] the prevalence of anemia in Indonesia is 21.7%, with 26.4% of patients with anemia aged 5-14 years and 18.4% of patients aged 15-24 years. The Household Health Survey Data (SKRT)[3] states that the prevalence of anemia among girls aged 10-18 years in 2012 was 57.1% and aged 19-45 years was 39.5%. Women are at risk of anemia, especially in young women. The incidence rate of anemia in Central Java in 2013 reached 57.1%, and the Women Aged Fertile (WUS) rate was 39.5%.

There are many types of anemia, but the most common is iron deficiency anemia, caused by deficiency of iron as the main ingredient of hemoglobin formation, resulting in hemoglobin synthesis disorder that eventually leads to decreased oxygen transport in blood.[4] Iron deficiency anemia is considered to be the most important factor in increasing the burden of disease worldwide, generally occurs in childhood and pregnant women.[1]

Young women have a higher risk of anemia than young men. First, it is because every month girls experience menstruation. A woman who has a lot of menstruation for more than five days is assumed to lose iron, so it requires more iron replacement than women whose menstruation is only three days and a little. Second is because young women often keep up appearances and desire to stay lean or thin by diet and eat less. However, imbalance diets with low nutrition will cause the body lack important nutrients such as iron.[5]

Generally, there are several factors that cause anemia, namely chronic blood loss or a lot of menstrual blood, menstrual period, insufficient iron intake, inadequate absorption and increased need for iron, nutritional status, malaria, other infections, and knowledge about anemia. The menstrual period and nutritional status are factors that are strongly associated with anemia. Normally, every day a woman will lose about 1-2 mg of iron through normal excretion.[5]

In the human body, the amount of iron varies greatly depending on the age, sex, and physiological condition of the body.[6] While in healthy adults, the amount of iron is estimated to be more than 4000 mg with about 2500 mg in hemoglobin. Some iron in the body (about 1000 mg) is stored in the liver with a form of ferritin. At a time when the consumption of iron from food is insufficient, ferritin is removed to produce hemoglobin. When the body does not produce iron from food due to less consumption of food containing iron, then iron reserves from ferritin are used continuously until depleted, which leads to anemia.[6]

Lack of micro and macronutrients cause the body becomes thin and weight drops drastically, short, anemia, sick constantly. Prawirohardjo[6] stated that the prevention of anemia in teenagers is by giving ferrous gluconas in 1 tablet a day. In addition, adolescents are encouraged to eat more protein and vegetables that contain lots of

minerals and vitamins. Sometimes iron tablets make unpleasant feelings such as abdominal pain, discomfort, nausea, constipation, black stools due to its high iron content of 200mg or 60mg elemental and 0.25mg of folic acid, which causes people tend not to obediently consume iron tablets.

Therefore, one of the alternatives that can be used to increase the blood profile level is by consuming a guava leaf (Psidii folium). Guava leaves are easy to find than guava fruits because they can grow in various regions in Indonesia. Guava leaves contain essential oils, tannin compounds, saponins, terpenoids, flavonoids, anthocyanins and alkaloids.[7] Study stated that guava leaf has been shown to have various pharmacological effects, including analgesic, anti-inflammatory, anti-viral and anti-tumor, anti-diarrheal, anti-cough, anti-bacterial, anti-plague, anti-diabetes, anti-hypertensive, hepato-protective, and antioxidants.[8] The content of flavonoids in guava leaf extract has antioxidant activity that works as a free radical catcher can certainly be used to repair or restore vascular endothelial function. Endothelial cells of blood vessels are layers of flat cells that line the inner surface of the blood vessels, and are directly related to blood and other blood products that flow in it.[9]

Antioxidants in flavonoids can donate their hydrogen atoms. Flavonoids will oxidize and bind to free radicals and become more stable compounds.[10] Phytochemical analysis by Arya's study[11] states that guava leaf extract has antioxidant compound activity (a compound of flavonoids) to reduce free radicals or the oxidation number in the blood. Thus, with the phenomena of anemia among teenage girls and the benefits of guava leaves. This study aims to examine the effect of consuming guava leaves (Psidii Folidum) extracts on changes in blood profile level in teenage girls at senior high school (SMK) of Palebon Semarang Indonesia.

METHODS

Design
This study was a quasi-experiment with pretest posttest control group design. This study was conducted at SMK Palebon Semarang conducted on December 2016 - January 2017.

Sample
A purposive sampling was used to select 36 samples in this study, with 18 samples were assigned in the experiment and control group. The inclusion criteria of the samples were teenage girls in the class XI, no consuming vitamins, and willing to be a respondent. The exclusion criteria were teenage girls who were sick, in the healing or therapeutic medications, and menstruating.

Intervention
The intervention was given to the experiment group was guava leaves extracts in the form of capsule (500 mg per capsule) produced by Dexa Medica, and Fe tablets at a dose of 60 mg per capsule for 14 days. While the control group was only given Fe tablets at dose 60 mg for 14 days. A blood sampling was performed prior to the intervention and after intervention (on the 15th day of post intervention). To control the bias in this study, researchers did screening and consultation to the participants about how to consume capsules of guava leaf extract and Fe tablets.

Instruments
Blood profiles was measured in the Laboratory of Cito Klinik Setiabudi to see the hemoglobin level, hematocrit level, erythrocyte count, and platelet count.

Data Analysis
Data were in normal distribution. Independent t-test was used to see the differences of blood profile before and after given intervention between the experiment and control group.

Ethical Consideration
The ethical clearance was obtained from the Health Research Ethics Committee of POLTEKKES KEMENKES Semarang with number 274 / KEPK / Poltekkes-SMG / EC / 2016. Informed consent has been performed to each respondent.

RESULTS

Table 1 shows that the average age of the respondents in the experiment group ranged between 16-17 years old and in the control group ranged between 16-18 years old. While mean value of BMI in the experiment group was 18.79 and in the control group was 17.44.

Table 1 Characteristics of the respondents based on age and body mass index (BMI) in teenage girls in SMK of Palebon Semarang

Variables	N	Experiment group	Control group
Age (year)			
Mean ± SD	18	16.33 ± 0.485	16.72 ± 0.575
Min-Max		16 - 17	16 - 18
BMI			
Mean ± SD	18	18.79 ± 1.327	17.44 ± 4,10
Min-Max		16.12 – 21.44	16.24 – 22.25

Table 2 Differences of mean value of hemoglobin, hematocrit, erythrocytes, and thrombocytes in the experiment and control group using Independent t-test

Variables	Group	Mean	SD	P-value
Hemoglobin	Experiment	13.37	1.58	0.042*
	Control	12.42	1.04	
Hematocrit	Experiment	37.33	3.13	0.332
	Control	36.42	2.35	
Erythrocytes	Experiment	4.63	0.28	0.537
	Control	4.70	0.36	
Thrombocytes	Experiment	371.94	54.1	0.003*
	Control	316.94	50.61	

Independent t-test results as shown in the table 2 indicates that there were significant differences in hemoglobin and thrombocytes levels after given intervention between the experiment and control group with p-value <0.05. The mean value of hemoglobin in the experiment group was 1.58 and the control group was 1.04. While the mean of thrombocytes in the experiment group was 54.1 and in the control, group was 50.61. It indicates that guava leaves extracts combined with Fe tablets have a significant effect on changes in blood

profile, especially in hemoglobin and thrombocytes levels in teenage girls, compared with the effect of Fe tablets alone. However, the intervention has no effect on hematocrit and erythrocytes levels.

DISCUSSION

Based on the results of this study, it could be concluded that consuming guava leaves (Psidii folium) extracts with dose 500 mg for 14 days have a significant effect on changes in hemoglobin and thrombocyte levels in teenage girls. This proves that flavonoid compounds in the guava leaves is effective.

Flavonoid compounds are polyphenol compounds that act as antioxidants, which in the blood cells can act as a container of hydroxyl and superoxide radicals that protect membrane lipids and prevent cell damage. Flavonoid compounds extracted from guava leaf can improve the process of erythrocyte (formation of erythrocytes) in the bone marrow and have immune-stimulatory effects.[11] In addition, antioxidant compound in the guava leaves extract could fight the free radical factions and prevent or delay unwanted oxidation or damage to DNA, protein and fat; and the process of blood cell formation can be increased, so that hemoglobin levels can be maintained. Previous study showed that the active ingredient of flavonoids could increase hemoglobin levels.[12]

In addition to the effect on hemoglobin, guava leaves extract also have an effect on thrombocytes level. This is in line with the previous study stated that flavonoid contains in guava leaves extract were allegedly able to increase the number of thrombocytes.[13] Similar with Masduki[14]

who explained that guava leaves extract can increase the number of megakaryocytes in bone marrow to increase the number of platelets in the blood. An increase in the number of megakaryocytes occurs through a mechanism of enhancement of GM-CSF (Granulocyte-Macrophage Colony Stimulating Factor) that will induce stimulation of proliferation and differentiation of megakaryocytes. Guava leaf also contains quercetin (from flavonoid group) that can increase the number of platelets because it contains amino acid serine and threonine that can form thrombopoietin which function in maturation process megakaryocytes become thrombocyte.

The theory described by Guyton and Hall[15] stated that the Thrombopoietin Hormone (TPO) is a hormone that controls platelet production. This hormone is produced in the liver and induced by inflammation. The decrease in megakaryocytes and platelets will stimulate TPO production. The results of this study indicated that the provision of guava leaf extract could affect the change in platelet count in young women. This is because the content of quercetin in guava leaves can stimulate Thrombopoietin (TPO) hormone.

This study also revealed that consuming guava leaves extract did not significantly influence to change of hematocrit level. Hematocrit is the ratio of the part of the blood containing erythrocytes to the blood volume, or the volume of all blood or red blood cell volume in percentage (%). The higher the percentage of hematocrit, the more concentration the blood will be. The hematocrit value is used to determine the mean of erythrocytes and to determine whether or not an anemia is present.

Hematocrit shows the percentage of red blood cells to total blood volume. Hematocrit values are usually proportional to the number of red blood cells at normal erythrocyte size.[16]

On the other hand, at an increasing age, the number of erythrocytes decreases, as the productivity of the spinal cord is also lower. The amount of erythrocytes may decrease because of the free radicals that attack cells so that the amount is not balanced between the numbers of cells present in the blood circulation with the numbers of cells synthesized.[17] However, increase in hematocrit level is proportional to the amount of erythrocytes. The number of normal hematocrit of women is 35 to 47%.[16] While the hematocrit level of teenage girls in this study after given guava leaves extract ranged between 30 to 42.4%, and in the control group ranged from 32.2 to 40.7%. It indicates that the hematocrit level in this study was still within normal limits, or it could be said that teenage girls in both groups were physiologically healthy.

Besides, findings of this study revealed that guava leaves extract did not significantly influence to change number of erythrocytes. However, the number of erythrocytes can be low because of the free radicals that attack cells, which leads to imbalance number of cells contained in the blood circulation with the number of cells in the synthesis. In addition, factors affecting the number of erythrocytes include age, species, food consumption and availability of erythrocyte production materials. Lack of food containing iron, vitamin B12 and folic acid will disrupt the process of hematopoiesis.[17]

Based on the theory proposed by Arisman[5] explained that teenagers prefer to consume fast food without paying attention to the fulfillment of nutrients in the food. Fast food (junk food), either as a snack or a large meal, contains very little calcium, iron, riboflavin, folic acid, vitamins A and C, but high in saturated fat content, cholesterol and sodium. Thus, it will affect the number of erythrocytes in the body and other blood cell components. The normal female erythrocyte count is 3.5 to 5.2 million cells per microliter (mcL).[16] While the erythrocyte count in teenage girls in this study ranged from 4.23 to 5.29 mcL and in the control group ranged from 4.28 to 5.52 to 106 mcL, which indicated that the erythrocytes levels in both groups were in normal levels.

CONCLUSION

Consuming guava leaves (Psidii folium) extracts with dose 500 mg for 14 days have a significant effect on changes in hemoglobin and thrombocyte levels in teenage girls, but not in the hematocrit and thrombocytes levels. Therefore, it is suggested that guava leaves (Psidii folium) extracts can be an alternative treatment for midwives to prevent the occurrence of anemia in teenage girls.

Authorship Contribution
All authors have equal contribution in this study.

References
1. Benoist Bd, McLean E, Egll I, Cogswell M. *Worldwide prevalence of anaemia 1993-2005: WHO global database on anaemia.* Geneva: World Health Organization; 2008.
2. MOH. Riset Kesehatan Dasar RISKESDAS [Basic Health Research]. Jakarta: Ministry of Health of the Respublic of Indonesia, Jakarta; 2013.
3. Depkes. *Survei kesehatan rumah tangga (Household health survey data).* Jakarta: Department of Health of the Republic of Indonesia; 2001.
4. Price SA, Wilson LM. *Patofisiologi konsep klinis proses-proses penyakit [Pathophysiology of clinical concepts of disease processes].* Jakarta: EGC; 2005.
5. Arisman MB. *Gizi dalam daur kehidupan [Nutrition in life style].* Jakarta: EGC; 2004.
6. Prawirohardjo S. *Ilmu Kebidanan [Obstetric].* 4th ed. Jakarta: Tridasa Printer; 2010.
7. Begum S, Hassan SI, Siddiqui BS. Two new triterpenoids from the fresh leaves of Psidium guajava. *Planta medica.* 2002;68(12):1149-1152.
8. Rochmasari Y. *Studi isolasi dan penentuan standar molekul senyawa kimia dalam fraksi netral daun jambu biji Australia (Psidium guajava L.) [Isolation study and standard determination of chemical compounds in neutral fraction of Australian guava leaves].* Depok, Jakarta: Fakultas Matematika dan Ilmu Pengetahuan Alam Program Studi S1 Kimia; 2011.
9. Li J, Chen F, Luo J. GC-MS analysis of essential oil from the leaves of Psidium guajava. *Zhong yao cai= Zhongyaocai= Journal of Chinese Medicinal Materials.* 1999;22(2):78-80.
10. Folashade O, Omoregie H, Ochogu P. Standardization of herbal medicines-A review. *International Journal of Biodiversity and Conservation.* 2012;4(3): 101-112.
11. Arya V, Thakur N, Kashyap CP. Preliminary phytochemical analysis of the extracts of Psidium leaves. *Journal of Pharmacognosy and Phytochemistry.* 2012; 1(1).
12. Miryanti YIPA, Sapei L, Budiono K, Indra S. Ekstraksi antioksidan dari kulit buah manggis (Garcinia mangostana L.) [Extraction of antioxydant from mangosteen rind]. *Research Report-Engineering Science.* 2011;2.
13. Gutiérrez RMP, Mitchell S, Solis RV. Psidium guajava: A review of its traditional uses, phytochemistry and pharmacology. *Journal of Ethnopharmacology.* 2008; 117(1):1-27.
14. Masduki I. Efek antibakteri ekstrak biji pinang (Areca catechu) terhadap S. aureus dan E. coli [Antibacterial effect of Areca catechu seed extract on S. aureus and E. coli]. *Cermin Dunia Kedokteran.* 1996; 109:21-24.
15. Guyton AC. *Human physiology and mechanisms of disease.* Philadelphia: WB Saunders Co; 1992.
16. Minsitry of Health of Indonesia. *Pedoman interpretasi data klinik [Guidelines for interpretatio of clinical data].* Jakarta: Kementerian Kesehatan Republik Indonesia; 2011.
17. Sherwood L. *Fisiologi manusia dari sel ke sistem [Human physiology from cell to system].* Jakarta: EGC; 2001.