CAVA SMOOTHIE AS AN ADJUVANT IN IRON SUPPLEMENTATION CAN INCREASE HEMOGLOBIN LEVELS AND ERYTHROCYTE INDICES IN ANEMIC ADOLESCENT GIRLS

Vina Dinata Kamila Aryani[1*], Muthmainah[2], Adi Magna Patriadi Nuhriawangsa[3]
[1]Program Studi Ilmu Gizi, Fakultas Sekolah Pascasarjana, Universitas Sebelas Maret, Surakarta, Indonesia
[2]Program Studi Histologi, Fakultas Kedokteran, Universitas Sebelas Maret, Surakarta, Indonesia
[3]Program Studi Peternakan, Fakultas Pertanian, Universitas Sebelas Maret, Surakarta, Indonesia
*E-mail: vinadinata67@student.uns.ac.id

ABSTRACT

Uncontrolled anemia leads to a decline in hemoglobin levels and erythrocyte blood indices, posing various health risks. To address this, a study aimed to assess the effectiveness of cava smoothies and iron supplementation in boosting hemoglobin levels and erythrocyte indices among anemic adolescent girls. The study involved 87 adolescent girls with moderate anemia, divided into three groups. The control group (C) received weekly iron tablets (60 mg), while two intervention groups (I1 and I2) were given the same iron tablets along with cava smoothies in increasing doses over 28 days. The results revealed significant improvements in hemoglobin levels. Group C showed an increase of 0.27 g/dL, while I1 and I2 demonstrated remarkable gains of 1.46 g/dL and 2.54 g/dL, respectively. Furthermore, erythrocyte indices (MCV, MCH, MCHC) exhibited positive changes. Group C saw increases of 0.35 fl, 0.34 pg, and 0.27 g/dL, I1 showed improvements of 0.69 fl, 0.61 pg, and 0.64 g/dL, and I2 experienced substantial enhancements of 1.97 fl, 1.61 pg, and 1.60 g/dL. In conclusion, the study confirmed that cava smoothies and iron supplementation effectively raise hemoglobin levels and improve erythrocyte indices in anemic adolescent girls, highlighting the potential benefits of this intervention for combating anemia.

Keywords: anemia, cava smoothie, hemoglobin, erythrocyte indices, iron supplementation

INTRODUCTION

Anemia is defined as a condition in which the hemoglobin levels are insufficient to meet the body's physiological needs (Miles & Richards, 2022). Anemia is associated with physical impairments, reduced quality of life, increased susceptibility to infections, elevated morbidity and mortality rates in women and children, decreased work productivity, cognitive impairments, and developmental disorders in preschool-age children and reproductive-aged women (Chaparro & Suchdev, 2019; Richards *et al*., 2021). Individuals with anemia are more commonly found among adolescent girls, as adolescent girls are relatively ten times more likely to experience anemia compared to adolescent boys (Kemenkes RI, 2018). The prevalence of anemia in Southeast Asia ranges from 14.0% to 46.0%, while in Indonesia, it stands at 28.0%, making Indonesia the fifth-ranked country in Southeast Asia regarding anemia prevalence (World Health Organization, 2016). Anemia due to iron deficiency, or Iron Deficiency Anemia (IDA), is an ongoing nutritional issue in Indonesia. Data from the Basic Health Research (Riskesdas) indicates that the prevalence of IDA among adolescents in Indonesia has increased from 37.0% in 2013 to 48.1% in 2018 (Martiasari *et al*., 2022; Badan Penelitian dan Pengembangan Kesehatan, 2018).

The management of anemia in adolescent girls can be carried out through a government program known as the Iron Supplementation Tablets (IST) program (Yudina & Fayasari, 2020). Circular Letter from the Ministry of Health of the Republic of Indonesia Number HK.03.03/V/0595/2016 regarding the provision of IST to Adolescent Girls and Women of Reproductive Age stipulates that IST should be given at a rate of 1 tablet per week per year (≥52 tablets/year). The consumption rate of IST in Indonesia remains low,

 Received 31-03-2023, Accepted 21-07-2023, Published online 30-09-2023.

with 98.6% of adolescent girls consuming fewer than 52 tablets per year and only 1.4% meeting the recommended intake (Nurcahyanti *et al*., 2022). The reason adolescent girls do not consume iron-fortified instant drinks (IFID) is due to feelings of boredom or laziness, as well as the unpleasant taste and aroma of IFID. Some adolescent girls also experience side effects such as nausea and upper abdominal pain (Ningtyias *et al*., 2020). Innovative supplementary beverages rich in iron and Vitamin C are required to increase hemoglobin levels and erythrocyte indices.

Several food items can be utilized to help increase hemoglobin levels and erythrocyte indices, such as *Cavendish bananas*, butter avocados, pure honey, and Sukkari dates. Bananas are a commonly found fruit in many countries, particularly in Asia (Garcı *et al*., 2015). The iron and vitamin C content in *Cavendish bananas* is relatively high, with 2.6 mg and 55.1 mg per 100 grams, respectively, both of which can assist in enhancing hemoglobin levels and erythrocyte indices (Aryani *et al*., 2022). *Cavendish bananas* contain 0.7 grams of protein, 0.1 grams of fat, and 19.8 grams of carbohydrates per 100 grams (Aryani et al., 2022). Avocado fruit has the potential to aid in addressing anemia in adolescent girls, as 100 grams of avocado contains 0.6 mg of iron and 8.80 mg of vitamin C (Dreher & Davenport, 2013). Avocado also contains 0.4 g of protein, 2.0 g of fat, and 8.7 g of carbohydrates in every 100 grams (Viera *et al*., 2022). Honey can increase hemoglobin levels and erythrocyte indices in the blood, as it contains 6.4 mg of iron and 10.7 mg of vitamin C every 100 grams (Islam *et al*., 2017). Honey also contains 6.1 g of protein, 0.5 g of fat, and 55.3 g of carbohydrates per 100 grams (Mustafa *et al*., 2023). Dates also possess the potential to assist in alleviating anemia in adolescent girls. This is caused by the fact that 100 grams of dates contain 10.4 milligrams of iron and 1.71 milligrams of vitamin C (Karajibani, 2019; Olabinjo *et al*., 2022). Additionally, within the same 100-gram portion, dates provide 2.0 grams of protein, 3.6 grams of fat, and 82.6 grams of carbohydrates (Zar Pasha *et al*., 2022).

The current popular beverage trend is the smoothie, which is primarily sold in fast-food establishments (Šilha *et al*., 2022). Smoothies are commonly consumed by children and adolescents (Fidler Mis *et al*., 2017). Smoothies not only offer a wealth of nutritious and healthful ingredients but also stand out due to their distinctive and unique presentation, making them more appealing to consumers (Malau *et al*., 2019). The preliminary examination conducted by the researcher determined that the composition of cava smoothie in 100 grams includes 4.1 grams of protein, 1.0 grams of fat, 30.6 grams of carbohydrates, 41.2 milligrams of vitamin C, and 12.5 milligrams of iron.

Many studies indicate that bananas, avocados, honey, and dates are local food sources with the potential to control anemia. The first study is being conducted by Rifiana & Hardiani (2021), which shows that the consumption of 100 grams of banana significantly increases hemoglobin levels over a 14-day period in anemic adolescent girls. Related research on the utilization of avocados is also being carried out by Feriyal (2017), showing that the consumption of 200 grams of avocado juice significantly increases hemoglobin levels over a 14-day period in anemic adolescent girls. Meanwhile, research on the potential of honey was conducted by Cholifah & Wulandari (2018), demonstrating that giving 3 tablespoons of honey per day for 14 days can significantly increase hemoglobin levels in anemic adolescent girls. Additionally, a study conducted by Susilawati (2022) indicates that the consumption of four dates over 7 days has a significant impact on increasing hemoglobin levels in anemic adolescent girls.

Although several researchers have conducted research on bananas, avocados, honey, and dates, a study on the combined effects of banana, avocado, honey, and dates in the form of a cava smoothie to improve hemoglobin levels and erythrocyte indices over a 28-day period, with the addition of iron supplementation, has never been undertaken. Therefore, this represents a novelty in research. Based on the description above, the researchers are interested in verifying whether a cava smoothie and iron supplementation can increase hemoglobin levels and erythrocyte indices in anemic adolescent girls.

METHOD

Data source and study design

This study was a quasi-experimental research with a pretest-posttest control group design. The study subjects consisted of adolescent girls with anemia, and the inclusion criteria were as follows: Adolescent girls with hemoglobin levels between 8.0-10.9 g/dL (experienced moderate anemia), aged 13-18 years, had regular menstruation occurring once a month (with cycles ranging from 21-35 days) for approximately 7 days, had a preference for bananas, avocados, honey, and dates, and did not suffer from chronic illnesses (such as intestinal parasites and malaria). Exclusion criteria included: Absence during data collection, illness during the study, and unwillingness to consume the cava smoothie. The research was conducted in five Islamic boarding schools in Metro City: Roudlotut Tholibin Islamic Boarding School (North Metro), Roudlatul Qur'an Islamic Boarding School (West Metro), Darul A'mal Islamic Boarding School (West Metro), Muhammadiyah At-Tanwir Islamic Boarding School (West Metro), and Daarul Ulya Islamic Boarding School (East Metro) in January-February 2023. The reason for selecting these five Islamic boarding schools as research locations was based on secondary data from the Metro City Health Office (year 2022), indicating that these boarding schools were in the top three areas with the highest prevalence of anemia in Metro City. From the population in these five boarding schools, a purposive sampling method was used to obtain a sample of 87 adolescent girls with moderate anemia.

The research subjects were then randomly divided into 3 groups, with each group consisting of a mix of individuals from various Islamic boarding schools. Each group comprised 29 adolescent girls, namely: Group C (Control Group), consisting of adolescent girls with anemia who were only given iron supplementation; Group I1 (Intervention Group 1), consisting of adolescent girls with anemia who were given iron supplementation (60 mg) and a cava smoothie at a dosage of 100 ml; and Group I2 (Intervention Group 2), consisting of adolescent girls with anemia who were given iron supplementation (60 mg) and a cava smoothie at a dosage of 200 ml. All adolescent girls with anemia were provided with iron supplementation in the form of Blood-Boosting Tablets at a dosage of 60 mg once a week if they were not menstruating and 7 times a week if they were menstruating. Adolescent girls with anemia were also given Cava Smoothie in two dosages: 100 ml and 200 ml every 2 days. The compliance level of the respondents in consuming iron supplementation and Cava Smoothie was assessed through the completion of questionnaires/forms in which they recorded the timing of iron supplementation and Cava Smoothie consumption, accompanied by their signatures and the endorsement of the responsible individuals at the Islamic boarding schools.

Research tools and materials

The research tools used to prepare the cava smoothie included: a blender, plastic cups, disposable hand gloves, measuring spoons, a kitchen scale, a knife, standing pouches, a refrigerator, and an ice cooling box. The research tools used for blood sample collection included: disposable gloves, 3 ml injection syringes, 3 ml EDTA tubes, 70% alcohol swabs, adhesive bandages, and a tourniquet. Meanwhile, the instrument used for analyzing blood serum (hemoglobin levels and erythrocyte indices) was the Dirui BC 3600 Hematology Analyzer.

The ingredients used to make a cava smoothie include: ripe white *Cavendish bananas* and ripe buttery avocados, pure honey, and Sukkari dates. The bananas and avocados were sourced from plantations in Lampung Province. Ripe bananas were selected based on characteristics such as bright, evenly yellow skin extending from the middle to the tips, a rounded shape, and smooth and soft banana skin (picked at 3 months of fruit age). The ripe avocados were selected based on characteristics such as dark green to deep purple skin, a soft texture, easy separation of the fruit from the skin, and easy removal of the seed from the flesh (picked at 6-7 months of fruit age). Pure honey and Sukkari dates were obtained from the Tayyiba store in Surakarta City.

The materials for the examination of hemoglobin levels and erythrocyte indices include 3 ml of blood drawn from a vein, 70% alcohol, and EDTA. Reagents for the examination of

hemoglobin levels and erythrocyte indices consist of hematology reagents such as Lyse, Cleanser, Diluent, and roll paper.

Preparation of cava smoothie

The cava smoothie was made from the flesh of Cavendish bananas, buttery avocados, pure honey, and Sukkari dates. The process of making Cava Smoothie began with handwashing and cleaning of utensils and ingredients. Plastic gloves were then worn. Cavendish bananas and buttery avocados were peeled and sliced. Slices of Cavendish bananas (75 g) and buttery avocados (75 g) were placed into a standing pouch and stored in the freezer overnight at a temperature of -17°C. After one night, once the bananas and avocados had frozen, they were transferred into a blender container. Pure honey (25 ml) and Sukkari dates (25 g) were added to the blender. All the ingredients were blended until smooth and homogeneous. The smoothie was then poured into 100 ml and 200 ml plastic cups (according to the research dosage). To keep the cava smoothie cold, it was placed in an ice-cooling box. The cava smoothie was ready to be served to the research subjects.

The gives of iron supplements and cava smoothie.

Before being given iron supplementation and cava smoothie treatment, research subjects were instructed on the stages that would be conducted in the study and a commercial brand of deworming medication (albendazole). The deworming medication was given as a single dose of 400 mg and taken 21 days before the treatment began. Iron supplementation was achieved by providing commercial-brand iron supplement tablets (iron-fortified tablets) containing 60 mg of iron per tablet. Iron supplement tablets were given once a week to research subjects who were not menstruating, and for research subjects who were menstruating, they were given once a day for 7 consecutive days, and after menstruation, they were given once a week. Iron supplement tablets were provided to all groups, including the control group (C) and the intervention groups (I1 and I2). In addition to receiving iron supplementation, the intervention groups also received a cava smoothie every 2 days. Group I1 received cava smoothie dose 1 (100 ml) every 2 days, while group I2 received dose 2 (200 ml) every 2 days. The treatment with iron supplements and a cava smoothie was carried out over a period of 28 days.

The examination of Hb levels and erythrocyte indices

The examination of Hb levels and erythrocyte indices to determine the effect of cava smoothie was conducted before and after the treatment, specifically 1 day before the treatment (H0) and after 28 days of treatment (H29). Blood collection and the examination of Hb levels and erythrocyte indices were performed at the Iringmulyo Public Health Center Laboratory, East Metro. Blood was drawn from the cubital vein using a 3 ml injection syringe, and then the blood was collected into a 3 ml EDTA tube (serum tube). Subsequently, the blood in the tube was diluted with Dirui BC 3600 reagent. The measurement of Hb levels and erythrocyte indices was performed using the impedance method, automatically calculating red blood cells (Isma et al., 2017). Hb levels are expressed in units of g/dL, while erythrocyte indices include MCV (mean corpuscular volume) expressed in units of fl, MCH (mean corpuscular hemoglobin) expressed in units of pg, and MCHC (mean corpuscular hemoglobin concentration) expressed in units of g/dL.

Data analysis

In this study, to determine the differences in Hb levels and erythrocyte indices before and after treatment within each group, data were analyzed using the Paired T-Test (for normally distributed data). However, for data with non-normal distribution, the Wilcoxon test was used for analysis. To determine the differences in the hemoglobin level and erythrocyte indices among the groups, the data were analyzed using the One-Way ANOVA test, followed by Post Hoc tests (for normally distributed data). However, for data with non-normal distribution, the Kruskal-Wallis test was used, followed by the Mann-Whitney test (Sumardiyono, 2020).

In this study, the significance level used is α=0.05. The analysis results are considered

significant if the p-value is less than 0.05 ($p<0.05$), and they are considered not significant if the p-value is greater than or equal to 0.05 ($p\geq0.05$).

Ethical approval

All procedures conducted in this study have been approved by the Research Ethics Committee of the Faculty of Medicine, Universitas Sebelas Maret Surakarta, with letter number 119/UN27.06.11/KEP/EC/2022 dated September 26, 2022.

RESULTS AND DISCUSSION

Respondent Characteristics

Table 1 presents the characteristics of the respondents, including Age, Education, and Hb Levels.

Table 1. Subject Characteristics

Variable	Category	Group						*p-value*
		C		I1		I2		
		N	%	N	%	N	%	
Age	Early Adolescents (10-13 years)	1	3.4	3	10.3	3	10.3	0.399
	Middle Adolescents (14-17 years)	26	89.7	24	82.8	25	86.3	
	Late Adolescents (18-24 years)	2	6.9	2	6.9	1	3.4	
	Total	29	100.0	29	100.0	29	100.0	
Education	Junior High School (*SMP/MTs*)	12	41.4	21	72.4	17	58.6	0.057
	Senior High School (SMA/MA)	17	58.6	8	27.6	12	41.4	
	Total	29	100.0	29	100.0	29	100.0	
Hb Levels	Mild Anemia (11,0-11,9g/dL)	0	0.0	0	0.0	0	0.0	0.332
	Moderate Anemia (8,0-10,9g/dL)	29	9.5	29	10.3	29	10.2	
	Severe Anemia (<8,0g/dL)	0	0.0	0	0.0	0	0.0	
	Total	29	100.0	29	100.0	29	100.0	

Note: C = Control Group (given iron supplementation 60 mg/week); I1 = Intervention Group 1 (given iron supplementation 60 mg/week and cava smoothie 100 ml/every 2 days); I2 = Intervention Group 2 (given iron supplementation 60 mg/week and cava smoothie 200 ml/every 2 days).

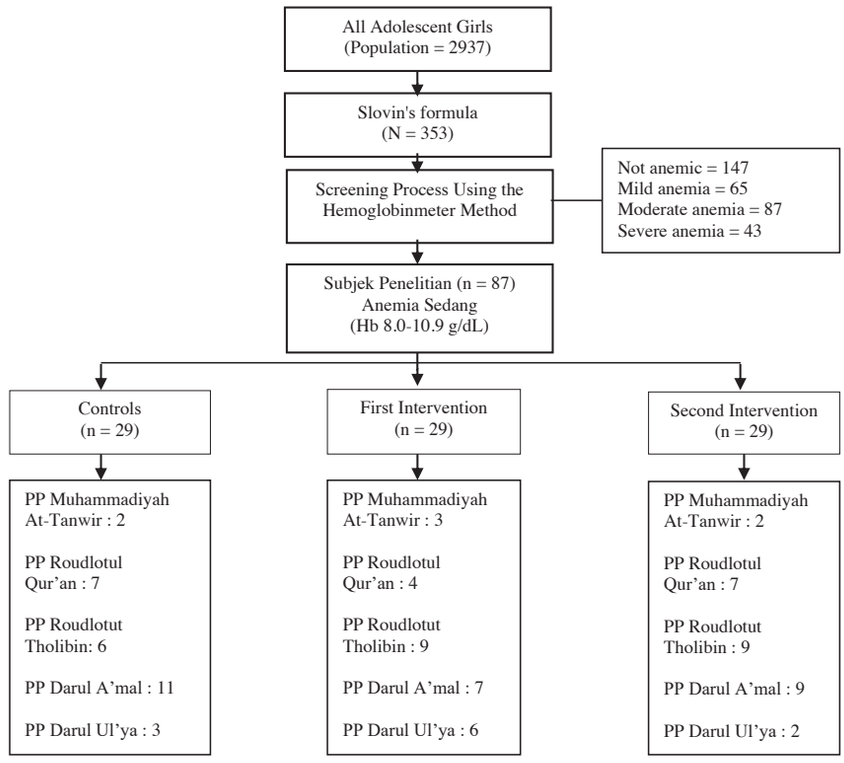

Figure 1. Research Subject Allocation Flowchart

Note: PP = Islamic Boarding School

Figure 1 illustrates that to divide the research subjects, it can begin by collecting all adolescent girls from 5 Islamic boarding schools in Metro City, totaling 2937 adolescent girls. Then, using Slovin's formula, 353 adolescent girls were selected. From these 353 adolescent girls, a screening process was conducted using the hemoglobinometer method, resulting in 147 non-anemic adolescent girls, 65 with mild anemia, 87 with moderate anemia, and 43 with severe anemia.

The researchers selected adolescent girls with moderate anemia because the intervention used was appropriate for addressing it, which is the provision of iron supplementation and cava smoothie. The researchers did not choose adolescent girls with mild anemia because mild anemia can be addressed simply by consuming iron-rich foods, whereas severe anemia cannot be addressed with just iron supplementation or cava smoothie alone. In other words, severe anemia requires more serious treatment compared to mild and moderate anemia.

The 87 research subjects, who were adolescent girls with anemia, were divided into 3 groups randomly, with each group consisting of 29 adolescent girls with anemia. These 29 adolescent girls with anemia were a combination of individuals from 5 Islamic boarding schools in Metro City.

Table 1 shows that the total research subjects were 87 respondents, with the majority of adolescent girls falling into the mid-teenage age group (14-17 years old), totaling 72 individuals. The highest educational level among the adolescent girls was junior high school (SMP/MTs), with 50 individuals. All adolescent girls had hemoglobin (Hb) levels categorized as moderate anemia, ranging from 8.0-10.9 g/dL. Based on the results of statistical tests, it was found that there was no significant difference among the three groups in terms of age, education, and Hb levels, indicating homogeneity among the research subjects (p-value > 0.05).

Giving Cava Smoothie and Iron Supplementation Increases Hemoglobin Levels

Table 2. Mean Hemoglobin Levels on Day 0 and Day 28, and the Difference in Each Group

Group	Mean ± SD (g/dL)			Kruskal-Wallis Test
	C	I1	I2	
Day 0	10.14 ± 0.60	10.05 ± 0.68	9.90 ± 0.78	0.653
Day 28	10.41 ± 0.29	11.51 ± 0.84	12.44 ± 0.79	0.001*
▲ (g/dL)	0.27 ± 0.57[a]	1.46 ± 0.96[b]	2.54 ± 1.24[c]	0.001*
Wilcoxon Test	0.140	0.001*	0.001*	

Note: C = Control Group (given iron supplementation 60 mg/week); I1 = Intervention Group 1 (given iron supplementation 60 mg/week and cava smoothie 100 ml/every 2 days); I2 = Intervention Group 2 (given iron supplementation 60 mg/week and cava smoothie 200 ml/every 2 days); a, b, c = Significantly different in Mann-Whitney Test; * = Significantly different (<0.05).

Figure 2. Bar Chart of Mean Hemoglobin Levels on Day 0 and Day 28 in Each Group
Legend: C = Control Group; I1 = Intervention Group 1; I2 = Intervention Group 2

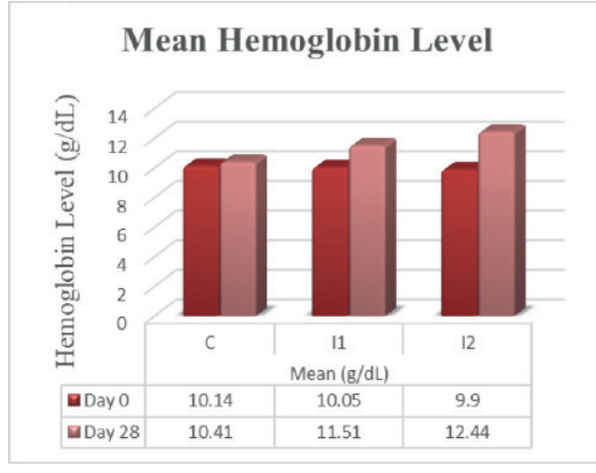

Table 2 and Figure 2 demonstrate that between day 0 and day 28, both intervention group 1 and intervention group 2 experienced a significant increase in hemoglobin levels, while the control group showed an increase in hemoglobin levels, but it is not statistically significant. The most substantial increase in hemoglobin levels is observed in intervention group 2, followed by intervention group 1, and the smallest increase is in the control group. The nonsignificant increase in hemoglobin levels in the control group suggests that providing iron supplementation alone may not lead to a significant improvement in hemoglobin levels in adolescent girls experiencing moderate anemia. This finding is inconsistent with the study by Jalambo *et al.* (2018), which indicated that consuming iron supplements could increase hemoglobin levels in the blood. This is because iron deficiency conditions can stimulate increased iron absorption in anemic subjects. Firstly, the absorbed iron can be utilized to normalize hemoglobin levels, ensuring that the supply of oxygen to tissues/cells is sufficient (Susanti *et al*., 2016). This means that providing iron supplementation alone may not effectively contribute to tissue/cell oxygenation.

The statistical test results in this study indicate that hemoglobin levels in intervention group 1 and intervention group 2 are significantly higher than those in the control group. This implies that cava smoothies, made from bananas, avocados, honey, and dates, when combined with iron supplementation, can significantly increase hemoglobin levels. As it is known from laboratory test results of its nutritional content, cava smoothie contains iron and vitamin C, among other nutrients. The presence of iron content can increase hemoglobin levels because iron is a component of the formation of hemoglobin (Abbaspour *et al*., 2014). Additionally, the presence of vitamin C content will also increase hemoglobin levels because vitamin C aids in the absorption of iron from food/drinks, allowing it to be processed into red blood cells once again (Chavan *et al*., 2021).

The statistical test results also indicate that the increase in hemoglobin levels in intervention group 2 is significantly higher compared to intervention group 1. Furthermore, in group I2, after receiving iron supplementation and cava smoothie, the mean hemoglobin level shows a normal value of 12.2 ± 0.6 mg/dL, while in group I1, the mean hemoglobin level is still below normal. This means that an increased dosage of cava smoothie can provide a more optimal increase in hemoglobin levels. The results of this study align with research conducted by Tuju *et al.* (2019), which showed that a combination of 200 g of bananas and 60 mg of iron supplementation for 7 days could significantly increase hemoglobin levels compared to iron supplementation alone. Another study conducted by Utami (2020), also indicates that the combination of 100 g of avocado and 60 mg of iron supplementation for 7 days can result in a higher increase in hemoglobin levels compared to iron supplementation alone. Damayanti *et al.* (2021) also researched the combination of 1 tablespoon of honey and 60 mg of iron supplementation for 14 days, resulting in a higher increase in hemoglobin levels than 60 mg of iron supplementation alone. Additionally, the study by Novadela & Imron (2015) showed that the combination of 2 dates and 60 mg of iron supplementation for 21 days could lead to a higher increase in hemoglobin levels compared to 60 mg of iron supplementation alone.

Bananas contain vitamin C, vitamin B1, energy, fat, carbohydrates, calcium, phosphorus, iron, and water (Ruspita *et al.*, 2022). The iron content in bananas can stimulate hemoglobin production in the blood (Adethia & Sukarni, 2022). The vitamin C content in bananas can accelerate the absorption of iron and help in the treatment of anemia patients (Mahardika & Zuraida, 2016). Consuming avocados, which are rich in iron and vitamin C, is very beneficial for the growth of red blood cells in the body and can help prevent and treat anemia, thus addressing complications resulting from anemia (Kiswari, 2018). Honey is a sweet-tasting herbal substance produced by honeybees from the nectar of flowers or liquids derived from plant matter, which is collected, modified, and combined into a positive compound by bees. The mineral magnesium content in honey is similar to the magnesium content in human blood serum. Similarly, the iron content in honey can increase the number of red blood cells in human blood and enhance hemoglobin levels (Panjaitan, 2018). Dates are a high-energy

source of nutrition with an ideal composition. They contain carbohydrates, tryptophan, omega-3, vitamin C, vitamin B6, Ca2, Zn, and Mg, and are rich in fiber. Additionally, they contain potassium, manganese, phosphorus, iron, sulfur, calcium, and magnesium.

The increase in hemoglobin levels occurs after the consumption of dates (As *et al*., 2021).

Giving Cava Smoothie and iron supplementation increases red blood cell indices (MCV, MCH, MCHC).

Table 3. Mean MCV (Mean Corpuscular Volume) on Day 0 and Day 28, and the Difference in Each Group

Group	Mean ± SD (fL)			Kruskal-Wallis Test
	C	I1	I2	
Day 0	79.05 ± 3.25	78.97 ± 6.47	78.82 ± 1.99	0.127
Day 28	79.40 ± 3.01	79.67 ± 6.50	80.79 ± 1.67	0.010*
▲ (fL)	0.35 ± 0.64[a]	0.69 ± 2.12[b]	1.97 ± 1.19[c]	0.001*
Wilcoxon Test	0.120	0.001*	0.001*	

Note: C = Control Group (given iron supplementation 60 mg/week); I1 = Intervention Group 1 (given iron supplementation 60 mg/week and cava smoothie 100 ml/every 2 days); I2 = Intervention Group 2 (given iron supplementation 60 mg/week and cava smoothie 200 ml/every 2 days); a, b, c = Significantly different in Mann-Whitney Test; * = Significantly different (<0.05).

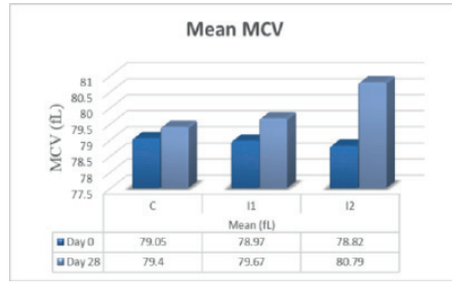

Figure 3. Bar Chart of Mean MCV on Day 0 and Day 28 in Each Group
Legend: C = Control Group; I1 = Intervention Group 1; I2 = Intervention Group 2.

Table 4. Mean MCH (Mean Corpuscular Hemoglobin) on Day 0 and Day 28 and the Difference in Each Group

Group	Mean ± SD (pg)			Kruskal-Wallis Test
	C	I1	I2	
Day 0	25.13 ± 0.69	25.05 ± 0.68	24.90 ± 0.77	0.616
Day 28	25.47 ± 0.39	25.66 ± 0.58	26.51 ± 0.84	0.001*
▲ (pg)	0.34 ± 0.62[a]	0.61 ± 0.69[b]	1.61 ± 0.99[c]	0.001*
Wilcoxon Test	0.050	0.010*	0.010*	

Note: C = Control group (given iron supplementation 60 mg/week); I1 = Intervention group 1 (given iron supplementation 60 mg/week and cava smoothie 100 ml/every 2 days); I2 = Intervention group 2 (given iron supplementation 60 mg/week and cava smoothie 200 ml/every 2 days). a, b, c = Significantly different in Post Hoc Test, * = Significantly different (<0.05).

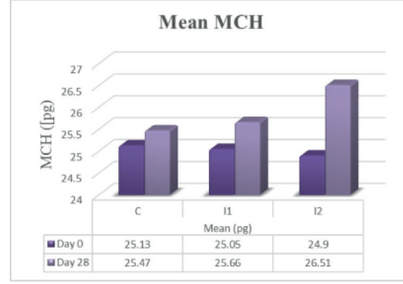

Figure 4. Bar Chart of Mean MCH on Day 0 and Day 28 in Each Group
Legend: C = Control Group; I1 = Intervention Group 1; I2 = Intervention Group 2

https://doi.org/10.204736/mgi.v18i3.188–200

Table 5. Mean MCHC (Mean Corpuscular Hemoglobin Concentration) on Day 0 and Day 28 and the Difference in Each Group

Group	Mean ± SD (g/dL)			Kruskal-Wallis Test
	C	I1	I2	
Day 0	32.13 ± 0.59	32.00 ± 0.68	31.88 ± 0.77	0.562
Day 28	32.40 ± 0.31	32.64 ± 0.60	33.48 ± 0.83	0.001*
▲ (%)	0.27 ± 0.55[a]	0.64 ± 0.66[b]	1.60 ± 0.99[c]	0.001*
Wilcoxon Test	0.090	0.010*	0.010*	

Note: C = Control Group (given iron supplementation 60 mg/week); I1 = Intervention Group 1 (given iron supplementation 60 mg/week and cava smoothie 100 ml/every 2 days); I2 = Intervention Group 2 (given iron supplementation 60 mg/week and cava smoothie 200 ml/every 2 days); a, b, c = Significantly different in Mann-Whitney test; * = Significantly different (<0.05).

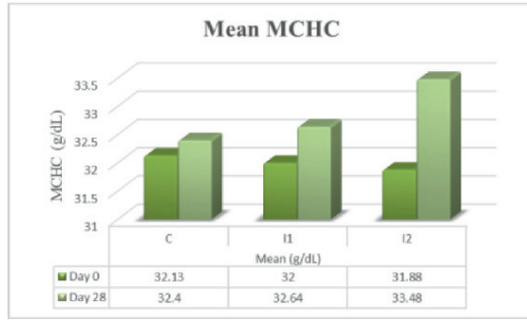

Figure 5. Bar Chart of Mean MCHC on Day 0 and Day 28 in Each Group
Legend: C = Control Group; I1 = Intervention Group 1; I2 = Intervention Group 2.

Tables 3, 4, and 5, as well as Figures 3, 4, and 5, indicate that between day 0 and day 28, both intervention groups 1 and 2 experienced a significant increase in MCV, MCH, and MCHC, while the control group showed an increase that was not statistically significant. The increase in MCV, MCH, and MCHC was most pronounced in intervention group 2, followed by intervention group 1, and was smallest in the control group. The non-significant increase in MCV, MCH, and MCHC in the control group indicates that iron supplementation alone may not significantly improve MCV, MCH, and MCHC in adolescent girls with moderate anemia. This finding is inconsistent with the study conducted by Zhang *et al.* (2020), which found that iron supplementation can significantly increase MCV in the blood. Dissimilar results were also found in a study conducted by Wahyuni (2021), which revealed that consuming iron supplements can significantly increase MCH and MCHC in the blood. T h e statistical analysis results in this study indicate that MCV, MCH, and MCHC in intervention group 1 and intervention group 2 are significantly higher than in the control group. This means that cava smoothies made from bananas, avocados, honey, and dates, when combined with iron supplementation, can significantly increase MCV, MCH, and MCHC levels. As known, based on the laboratory analysis of nutritional content, cava smoothie contains, among other things, iron and vitamin C. Iron and vitamin C are best consumed together. Vitamin C assists the body in absorbing non-heme iron by binding to it and helping it flow into the intestines. When vitamin C binds with non-heme iron, it enhances its stability and solubility. This allows the body to more easily absorb iron through the intestinal mucosa (Piskin *et al*., 2022).

The statistical results also indicate that the increase in MCV, MCH, and MCHC in intervention group 2 is significantly higher compared to intervention group 1. This means that an increase in the dosage of cava smoothie can provide a more optimal effect on MCV, MCH, and MCHC. In this study, cava smoothie was administered over a period of 28 days with a graded dosage, namely 100 ml every 2 days and 200 ml every 2 days. MCV, or Mean Corpuscular Volume, serves to measure the average size of red blood cells, and if MCV is low, it indicates that the red blood cells are very small. MCH and MCV are directly related;

if MCV increases, MCH will also increase, and if MCV is low, MCH will be low as well (Peng *et al.*, 2021). MCH is directly proportional to MCHC; if MCH increases, then MCHC will also increase. The increase in MCHC occurs due to the improving condition of iron-deficiency anemia (Fitriany & Saputri, 2018).

CONCLUSION AND RECOMMENDATIONS

It can be concluded that giving Cava Smoothie and iron supplementation is effective in increasing hemoglobin levels and red blood cell indices (MCV, MCH, and MCHC) in anemic adolescent girls ($p<0.05$). However, further research is needed to examine parameters for anemia beyond hemoglobin levels and red blood cell indices, such as hepcidin and serum ferritin.

ACKNOWLEDGMENTS

We would like to express our gratitude to the Unity of the Nation and Politics Agency of Metro City, the Metro City Health Department, and the Iringmulyo East Metro Public Health Center Laboratory for their facilitation and assistance in this research.

DAFTAR PUSTAKA

Abbaspour, N., Hurrell, R., & Kelishadi, R. (2014). Review on iron and its importance for human health. *Journal of Research in Medical Sciences*, *19*(2), 164–174.

Adethia, K., & Sukarni. (2022). The Effect of Giving Ambon Banana to Increasing Haemoglobin Levels in Takengon Adolescence in the Junior High School 42 in 2022. *Science Midwifery*, *10*(4), 3355–3358. https://doi.org/10.35335/midwifery.v10i4.809

Aryani, V. D. K., Muthmainah, & Nuhriawangsa, A. M. P. (2022). *Acceptance Test of Cava Smoothie as an Alternative Drink for Anemic Adolescent Girls* (Vol. 2). Atlantis Press International BV. https://doi.org/10.2991/978-94-6463-070-1

As, S., Sinrang, W., Ahmad, M., & Hidayanty, H. (2021). Addition Of Sukkari Dates (Phoenix Dactylifera L) And Fe Supplementation In Increasing Ferritin Levels To Young Women With Anemia. *Annals of R.S.C.B*, *25*(4), 17377–17389.

Badan Penelitian dan Pengembangan Kesehatan. (2018). Laporan_Nasional_RKD2018_FINAL.pdf. In *Badan Penelitian dan Pengembangan Kesehatan* (p. 198). http://labdata.litbang.kemkes.go.id/images/download/laporan/RKD/2018/Laporan_Nasional_RKD2018_FINAL.pdf

Chaparro, C. M., & Suchdev, P. S. (2019). Anemia epidemiology, pathophysiology, and etiology in low- and middle-income countries. *Annals of the New York Academy of Sciences*, *1450*(1), 15–31. https://doi.org/10.1111/nyas.14092

Chavan, S., Rana, P., Tripathi, R., & Tekur, U. (2021). Comparison of efficacy & safety of iron polymaltose complex & ferrous ascorbate with ferrous sulphate in pregnant women with iron-deficiency anaemia. *Indian Journal of Medical Research*, *154*(21), 78–84. https://doi.org/10.4103/ijmr.IJMR_1753_18

Cholifah, N., & Wulandari, A. (2018). Aplikasi Pemberian Madu Terhadap Peningkatan Hemoglobin (Hb) pada Remaja Putri yang Mengalami Anemia. *University Research Colloquium*, *September*, 533–539.

Damayanti, D. F., Astuti, W., Wati, E., & Marsita, E. (2021). Efektivitas Madu dan Tablet Fe sebagai Upaya Peningkatan Kadar Hemoglobin pada Remaja Putri di Pondok Pesantren. *Journal of Nutrition College*, *10*(2), 93–99. https://doi.org/10.14710/jnc.v10i2.29144

Dreher, M. L., & Davenport, A. J. (2013). Hass Avocado Composition and Potential Health Effects. *Critical Reviews in Food Science and Nutrition*, *53*(7), 738–750. https://doi.org/10.1080/10408398.2011.556759

Ernawati, F., Oktaria, Y., & Khomsan, A. (2018). *Peluang Generasi Bangsa yang Terabaikan Anemia Baduta*. IPB Press.

Feginanda, R., Soebiyanto, S., & Darmawan, P. (2018). Penentuan Kadar Protein Pada Ampas Bir Limbah Industri Pabrik Bir. *Biomedika*, *10*(2), 69–72. https://doi.org/10.31001/biomedika.v10i2.277

Feriyal. (2017). Pengaruh Pemberian Jus Alpukat (Persea Americana [Mill]) Terhadap Peningkatan Kadar Hemoglobin Ibu Hamil TM II Di Puskesmas Sindang Kabupaten Indramayu. *Jurnal Kesehatan Indra Husada*, *7*(2), 93–99.

Fidler Mis, N., Braegger, C., Bronsky, J., Campoy, C., Domellöf, M., Embleton, N. D., Hojsak, I., Hulst, J., Indrio, F., Lapillonne, A., Mihatsch, W., Molgaard, C., Vora, R., & Fewtrell, M. (2017). Sugar in Infants, Children and Adolescents:

A Position Paper of the European Society for Paediatric Gastroenterology, Hepatology and Nutrition Committee on Nutrition. *Journal of Pediatric Gastroenterology and Nutrition*, *65*(6), 681–696. https://doi.org/10.1097/MPG.0000000000001733

Fitriany, J., & Saputri, A. I. (2018). Anemia Defisiensi Besi. *AVERROUS: Jurnal Kedokteran Dan Kesehatan Malikussaleh*, *4*(2), 1. https://doi.org/10.29103/averrous.v4i2.1033

Garcı, O. P., Martı, M., Romano, D., Camacho, M., Moura, F. F. De, Abrams, S. A., Khanna, H. K., Dale, J. L., & Rosado, J. L. (2015). Iron Absorption in Raw and Cooked Bananas: A Field Study Using Stable Isotopes in Women. *Food & Nutrition Research*, *1*, 1–7.

Haristantya, R. A. (2018). *Penetapan Kadar Glukosa Pada Bunga Brokoli (Brassica oleracea var Italica) Menggunakan Metode Spektrofotometri Uv-Vis* (Vol. 7, Issue 2). Sekolah Tinggi Ilmu Kesehatan Nasional Surakarta.

Islam, M. R., Pervin, T., Hossain, H., Saha, B., & Hossain, S. J. (2017). Physicochemical and Antioxidant Properties of Honeys from the Sundarbans Mangrove Forest of Bangladesh. *Preventive Nutrition and Food Science*, *22*(4), 335–344. https://doi.org/10.3746/pnf.2017.22.4.335

Isma, J., Usman, S., Pemeriksaan, K., & Analyzer, H. (2017). *Pemeriksaan Kadar Darah Rutin Menggunakan Hematologi Analyzer*. 1–5.

Jalambo, M., Karim, N., Naser, I., & Sharif, R. (2018). Effects of iron supplementation and nutrition education on haemoglobin, ferritin and oxidative stress in iron-deficient female adolescents in Palestine: Randomized control trial. *Eastern Mediterranean Health Journal*, *24*(6), 560–568. https://doi.org/10.26719/2018.24.6.560

Karajibani, M. (2019). The Effect of a Date Consumption-Based Nutritional Program on Iron Defi ciency Anemia in Primary School Girls Aged 8 to 10 Years Old in Zahedan (Iran). *Pediatric Health, Medicine and Therapeutics*, *2019*(10), 183–188. https://doi.org/https://doi.org/10.2147/PHMT.S225816

Kemenkes RI. (2018). Profil Kesehatan Kemenkes RI. In *Profil Kesehatan Kemenkes RI*. file:///C:/Users/HP/Downloads/PROFIL_KESEHATAN_2018.pdf

Kiswari, R. (2018). *Hematologi dan Transfusi*. Erlangga.

Laloan, R. J., Marunduh, S. R., & Sapulete, I. M. (2018). Hubungan Merokok Dengan Nilai Indeks Eritrosit (Mcv, Mch, Mchc) Pada Mahasiswa Perokok. *Jurnal Medik Dan Rehabilitasi (JMR)*, *1*(2), 1–6.

Li, N., Zhao, G., Wu, W., Zhang, M., Liu, W., Chen, Q., & Wang, X. (2020). The Efficacy and Safety of Vitamin C for Iron Supplementation in Adult Patients With Iron Deficiency Anemia: A Randomized Clinical Trial. *JAMA Network Open*, *3*(11), e2023644. https://doi.org/10.1001/jamanetworkopen.2020.23644

Mahardika, N. P., & Zuraida, R. (2016). Vitamin C pada Pisang Ambon (Musa paradisiaca S.) dan Anemia Defisiensi Besi. *Majority*, *5*(4), 124. http://elib.fk.uwks.ac.

Malau, R. M., Windia, W., & Agung, D. G. (2019). Faktor-faktor yang Menentukan Keputusan Konsumen dalam Pembelian dan Konsumsi Smoothie Bowl di Restoran Nalu Bowls Seminyak. *Jurnal Agribisnis Dan Agrowisata ISSN*, *3685*(3), 3809.

Martiasari, A., St, D. R., M, S. M., & Maula, S. I. (2022). Hubungan Pengetahuan Status Gizi dan Pola Menstruasi Pada Anemia Remaja Putri. *SIMFISIS Jurnal Kebidanan Indonesia*, *01*, 131–137. https://doi.org/10.53801/sjki.v1i3.18

Miles, L. F., & Richards, T. (2022). Hematinic and Iron Optimization in Peri-operative Anemia and Iron Deficiency. *Current Anesthesiology Reports*, *12*(1), 65–77. https://doi.org/10.1007/s40140-021-00503-z

Mustafa, G., Iqbal, A., Javid, A., Hussain, A., Bukhari, S. M., Ali, W., Saleem, M., Azam, S. M., Sughra, F., Ali, A., Rehman, K. U., Andleeb, S., Sadiq, N., Hussain, S. M., Ahmad, A., & Ahmad, U. (2023). Variations in nutritional profile of honey produced by various species of genus Apis. *Brazilian Journal of Biology*, *83*, 1–6. https://doi.org/10.1590/1519-6984.246651

Ningtyias, F. W., Quraini, D. F., & Rohmawati, N. (2020). Perilaku Kepatuhan Konsumsi Tablet Tambah Darah Remaja Putri di Jember, Indonesia. *Jurnal PROMKES*, *8*(2), 154. https://doi.org/10.20473/jpk.v8.i2.2020.154-162

Novadela, N. I. T., & Imron, R. (2015). Pengaruh Pemberian Tablet Fe Dan Buah Kurma Pada Mahasiswi Di Jurusan Kebidanan Tanjungkarang. *Jurnal Keperawatan.*, *XI*(2), 305–309.

Nurcahyanti, W. O., Lisnawaty, & Muchtar, F. (2022). Analisis Pelaksanaan Program Pemberian Tablet Tambah Darah Pada Remaja Putri Di Wilayah Kerja Puskesmas Usuku

Kabupaten Wakatobi Tahun 2021. *Jurnal Gizi Dan Kesehatan Indonesia*, *2*(4), 134–142.

Olabinjo, O. O., Sama, M. O., & Babatope, O. S. (2022). Evaluation of Nutritional Composition of Ripe Date Fruit (Phoenix Dactylifera L.) pulp and Seed grown in Nigeria. *International Journal of Environment , Agriculture and Biotechnology (IJEAB)*, *7*(2), 123–128. https://doi.org/10.22161/ijeab

Panjaitan, K. S. D. (2018). Formulasi Sediaan Masker Gel dari Ekstrak Etanol Buah Labu Kuning (Cucurbita moschata Durch.) dan Madu (Mel Depuratum). In *FORMULASI SEDIAAN MASKER GEL EKSTRAK ETANOL BUAH LABU KUNING (Cucurbita Moschata Durch.) DAN MADU (Mel Depuratum)* (Vol. 1). Institut Kesehatan Helvetia.

Pargiyanti. (2019). Optimasi Waktu Ekstraksi Lemak Dengan Metode Soxhlet Menggunakan Perangkat Alat Mikro Soxhlet. *Indonesian Journal of Laboratory*, *1*(2), 29–35.

Peng, Q., Zhang, Z., Li, S., Cheng, C., Li, W., Rao, C., Zhong, B., & Lu, X. (2021). Molecular epidemiological and hematological profile of thalassemia in the Dongguan Region of Guangdong Province, Southern China. *Journal of Clinical Laboratory Analysis*, *35*(2), 1–7. https://doi.org/10.1002/jcla.23596

Piskin, E., Cianciosi, D., Gulec, S., Tomas, M., & Capanoglu, E. (2022). Iron Absorption: Factors, Limitations, and Improvement Methods. *ACS Omega*, *7*(24), 20441–20456. https://doi.org/10.1021/acsomega.2c01833

Richards, T., Baikady, R. R., Clevenger, B., Butcher, A., Abeysiri, S., Chau, M., Swinson, R., Collier, T., Dodd, M., Van Dyck, L., Macdougall, I., Murphy, G., Browne, J., Bradbury, A., & Klein, A. (2021). Preoperative intravenous iron for anaemia in elective major open abdominal surgery: The PREVENTT RCT. *Health Technology Assessment*, *25*(11), 1–86. https://doi.org/10.3310/HTA25110

Rifiana, A. J., & Hardiani. (2021). *Pengaruh Pemberian Buah Pisang Ambon Terhadap Kadar Hemoglobin Ibu Hamil Dengan Anemia Di Klinik Fs Munggaran Kabupaten Garut Jawa Barat*.

Rohyani, I. S., Aryanti, E., & Suripto. (2015). Potensi Nilai Gizi Tumbuhan Pangan Lokal Pulau Lombok Sebagai Basis Penguatan Ketahanan Pangan Nasional Pulau lombok merupakan salah satu wilayah di Mayoritas penduduknya dihuni oleh masyarakat suku sasak yang merupakan masyarakat asli daerah i. *Jurnal Sains Teknologi & Lingkungan*, *1*(1), 43–47.

Ruspita, R., Rahmi, R., & Nurlela. (2022). Effect of consuming ambon banana on increasing hemoglobin levels in pregnant women. *Science Midwifery*, *10*(5), 4254–4258. https://doi.org/10.35335/midwifery.v10i5.1007

Safitri, B. R. A., & Ramdani, L. M. A. (2018). Analisis Kandungan Mineral Logam Besi (Fe) Batuan Di Kawasan Pertambangan Emas Desa Bangkang Tengah Dengan Menggunakan Metode AAS. *Jurnal Ilmiah IKIP Mataram*, *5*(2), 101–104.

Šilha, D., Syrová, P., Syrová, L., & Janečková, J. (2022). Smoothie Drinks: Possible Source of Resistant and Biofilm-Forming Microorganisms. *Foods*, *11*(24), 1–15. https://doi.org/10.3390/foods11244039

Sumardiyono. (2020). Buku Panduan Metodologi Penelitian 2. In *Syria Studies* (Vol. 7, Issue 1). Fakultas Kedokteran Universitas Sebelas Maret. https://www.researchgate.net/publication/269107473_What_is_governance/link/548173090cf22525dcb61443/download%0Ahttp://www.econ.upf.edu/~reynal/Civil wars_12December2010.pdf%0Ahttps://think-asia.org/handle/11540/8282%0Ahttps://www.jstor.org/stable/41857625

Susanti, Y., Briawan, D., & Martianto, D. (2016). Suplementasi Besi Mingguan Meningkatkan Hemoglobin. *J. Gizi Pangan*, *11*(1), 27–34. yeti.susantigz83@gmail.com

Susanto, Z. A., Marsudi, L. O., & Sulastri, N. (2022). Pemeriksaan Indeks Eritrosit Menggunakan Alat Mindray Bc-5150 Di Laboratorium RSUD AWS. *Jurnal Teknologi Laboratorium Medik Borneo*, *2*(77), 69–73.

Susilawati, E. (2022). Consumption of Dates in Adolescent Increase Hemoglobin Levels. *Jurnal Ibu Dan Anak*, *10*(1), 40–44.

Tuju, S. O., Yasmari, N. K., Lontaan, A., & Losu, F. N. (2019). Efektivitas Pemberian Kombinasi Pisang Ambon [Musa Paradisiaca Var . Sapientum] dan Tablet Fe Terhadap Kadar Hemoglobin pada Ibu Hamil Trimester III di Puskesmas Pinolosian. *Poltekkes Kemenkes Manado*, *01*(02), 74–85.

Utami, T. P. A. (2020). Pengaruh Pemberian Tablet Fe + Jus Avokad (Persea Americana Mill) Terhadap Kadar Hemoglobin Ibu Hamil Trimester II Di PMB Suryani Kecamatan

Medan Johor Tahun 2019. *COLOSTRUM : Jurnal Kebidanan*, *1*(2), 16–24. https://doi.org/10.36911/colostrum.v1i2.688

Viera, I., Herrera, M., & Roca, M. (2022). Influence of food composition on chlorophyll bioaccessibility. *Food Chemistry*, *386*(December 2021), 132805. https://doi.org/10.1016/j.foodchem.2022.132805

Wahyuni, E. S. (2021). Pengaruh Suplementasi Fe dan Vitamin C terhadap Hemoglobin dan Indeks Eritrosit Remaja Putri. *Jurnal Kesehatan*, *12*(2), 162. https://doi.org/10.26630/jk.v12i2.2482

World Health Organization. (2016). WORLD HEALTH STATISTICS - MONITORING HEALTH FOR THE SDGs. In *World Health Organization*.

Yudina, M. K., & Fayasari, A. (2020). Evaluasi Program Pemberian Tablet Tambah Darah Pada Remaja Putri di Jakarta Timur. *Jurnal Ilmiah Kesehatan (JIKA)*, *2*(3), 147–158.

Zar Pasha, A., Anwer Bukhari, S., Ali El Enshasy, H., El Adawi, H., & Al Obaid, S. (2022). Compositional analysis and physicochemical evaluation of date palm (Phoenix dactylifera L.) mucilage for medicinal purposes. *Saudi Journal of Biological Sciences*, *29*(2), 774–780. https://doi.org/10.1016/j.sjbs.2021.10.048

Zhang, B., Sui, F., Wang, B., Wang, Y., & Li, W. (2020). Dietary combined supplementation of iron and Bacillus subtilis enhances reproductive performance, eggshell quality, nutrient digestibility, antioxidant capacity, and hematopoietic function in breeder geese. *Poultry Science*, *99*(11), 6119–6127. https://doi.org/10.1016/j.psj.2020.06.077