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Processing of Undis Bean (Cajanus Cajan L.) and Iron-Folic Acid Supplementation Increase Hemoglobin and Hematocrit Levels Post-Blood Donation

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ABSTRACT

This study aims to demonstrate the efficacy of processed pigeon pea (Cajanus cajan L.) combined with iron-folic acid supplementation in increasing hemoglobin and hematocrit levels following blood donation. Processing of Undis Bean (Cajanus cajan L.) and Iron-Folic Acid Supplementation Increase Hemoglobin and Hematocrit Levels Post-Blood Donation. This experimental research employed a randomized pre-test/post-test control group design. Sixty-four blood donors aged 17–65 years who successfully donated at the Badung Regency Red Cross Mobile Unit in July 2024 were enrolled and divided into two groups: control group (K) receiving iron-folic acid supplementation (IFAS) only, and treatment group (P) receiving IFAS with 50 grams of processed pigeon pea daily. The intervention was administered for 7 days, after which hemoglobin and hematocrit levels were examined using the Photometric Point of Care Testing (POCT) method. Results demonstrated significant increases in both hemoglobin and hematocrit levels between pre-test and post-test in each group (p=0.000). Comparison between groups revealed significantly greater hemoglobin increases in group P (p=0.028) and hematocrit increases in group P (p=0.015). This study concludes that providing processed pigeon pea combined with IFAS for 7 days significantly increases hemoglobin and hematocrit levels after blood donation, offering a practical nutritional intervention to support post-donation recovery.

KEYWORDS *Blood Donation Recovery; Hemoglobin and Hematocrit; Pigeon Pea.*

INTRODUCTION

Blood donation is a social activity in which a person voluntarily gives a portion of their blood to be stored in a blood bank and later provided to patients in need. In the donation process, the amount of donated blood varies between 350–500 mL per bag. Many studies have reported the benefits of blood donation, such as lowering blood pressure, reducing fat levels, and decreasing the risk of heart disease (Liu et al., 2022). Globally, blood donation systems face persistent challenges in maintaining adequate blood supplies while ensuring donor safety and promoting donor retention (WHO, 2021). According to the World Health Organization (WHO), an estimated 1% of a country's population is needed to donate blood. Indonesia, as the fourth most populous country in the world with approximately 278 million inhabitants, must therefore give serious attention to the adequacy of its blood supply. Meeting this target requires not only recruitment of new donors but also strategies to facilitate safe and timely repeat donations (PMI, 2022). Before donating blood, prospective donors undergo health

screening to assess their eligibility (PMI, 2022). To fulfill blood reserves, regular donors are required to donate at least 8 weeks after the previous donation, which is the minimum interval allowed. In other countries, such as Japan, the interval is 12 weeks for men and 16 weeks for women, while in England the maximum allowed is 3–4 donations per year (Lee, 2020).

In Indonesia, low hemoglobin levels represent a significant barrier to blood donation eligibility and donor retention. Donors may give blood only if their hemoglobin level ranges from 12.5–17 g/dL. According to the American Health Organization, low hemoglobin is the fourth most common reason for delays in blood donation in America, particularly among women. The loss of iron after donating blood may cause physiological changes such as fatigue, decreased exercise capacity, impaired concentration, and reduced learning and memory abilities (Urbina, 2022). Hemoglobin is a component of erythrocytes containing ferroprotoporphyrin and globin, and it is synthesized in the mitochondria. Hemoglobin functions in oxygen and carbon dioxide exchange, nutrient transport, metabolic waste transport, and immune system processes. Normal hemoglobin levels in men range from 13–17.5 g/dL, whereas in women the normal range is 12–15.5 g/dL (Aliviameita & Puspitasari, 2019).

In the 2022 Badung Regency PMI report, out of 4,205 donors, 331 people (7.9%) were rejected due to low hemoglobin levels. Meanwhile, the total blood needed in 2022 was 5,083 bags, indicating a shortage of blood to meet patient demands (PMI Badung, 2022). A decrease in hemoglobin after blood donation has been reported with significant results. In one study involving 30 donors, hemoglobin levels measured using the cyanmethemoglobin method decreased from 14.84 g/dL before donation to 12.63 g/dL afterward, where 21 individuals (70%) had hemoglobin levels that met the criteria for anemia after donation (Amalia, 2019).

Another study found differences in hemoglobin levels among 100 donors. Among 39 male donors, hemoglobin levels before donation were 14–18 g/dL; after donation, seven donors experienced a decrease to 10–13 g/dL, while 32 donors remained at 14–18 g/dL. Among female donors, one person had a pre-donation hemoglobin level of 10–13 g/dL and 14 had levels of 14–18 g/dL, but after donation, 15 donors fell within the 10–13 g/dL range (Zainuddin & Fahmy, 2015). Hemoglobin recovery time requires longer than the minimum donation interval. Risk factors include women under 30 years of age due to menstruation, pregnancy, and breastfeeding. However, donors who give blood frequently (more than 15 times) have a faster hemoglobin recovery than those who donate infrequently (Niittymaki, 2017).

Hematocrit is another indicator of blood volume status besides hemoglobin. Hematocrit represents the percentage of erythrocyte volume per milliliter of blood. Hematocrit and hemoglobin correlate closely, with hematocrit normally three times the hemoglobin level. Normal hematocrit levels are 37–43% in women and 40–48% in men. Hematocrit decreases in conditions such as anemia, bleeding, and hyperthyroidism, while elevations occur in dehydration, chronic lung disease, and shock (Mentari & Nugraha, 2023). Donor hematocrit levels also decrease after blood donation. One study reported an average decrease in hematocrit from 43.3% to 40.2% in 30 donors. Low post-donation hematocrit levels increased among male respondents (7 individuals) and adults aged 25–44 years (4 individuals) (Nafsi & Sofyanita, 2023).

Iron is an essential component of the body, particularly for hemoglobin formation. A decrease in iron levels will lead to a decline in hemoglobin. Reduced iron stores disrupt ferritin

reserves and interfere with erythropoiesis, potentially causing iron deficiency anemia. A donor loses approximately 200–250 mg of iron for every 350–450 mL of donated blood (Widiyawati et al., 2021). Donors generally receive iron supplements to help replenish iron lost after blood donation. Studies indicate that donors with iron deficiency who receive supplementation may still experience relative anemia after 120 days. Donors with normal hemoglobin who do not take iron tablets require more than 168 days to restore iron reserves (ferritin) to pre-donation levels (Kiss et al., 2015). Many donors do not take iron supplements after donating blood. Iron plays a vital role in biochemical and physiological processes related to hemoglobin and oxygen transport. Loss of iron after donation can lead to iron deficiency. Clinically, iron deficiency consists of three phases, two of which are subclinical and occur without anemia: the first phase is iron depletion, the second is iron-deficient erythropoiesis, and the third phase is iron deficiency anemia. Frequent donors commonly experience subclinical iron deficiency (Aura, 2015).

Indonesia is known for its abundant natural resources and fertile land. Bali, besides being a major tourist destination, also has extensive agricultural and plantation land producing rice, legumes, fruits, and vegetables that can be utilized by the community. In Balinese, pigeon pea is known as *kacang undis*, a type of legume that can be used as a local food source (Maulidina, 2021). Pigeon pea (*Cajanus cajan*) grows widely in tropical and subtropical regions. India is the largest producer in the world, while in Indonesia annual production reaches approximately 50 tons of dry seeds. Young seeds are commonly used as vegetables, whereas mature seeds are used in dishes such as *rempeyek* and *serundeng* (Krisnawati, 2005).

Kacang undis can support food security due to its protein, carbohydrate, vitamin, and mineral content. In 100 grams of *kacang undis*, there are approximately 20.7 grams of protein, 1.4 grams of fat, 62 grams of carbohydrates, 125 mg of calcium, 275 mg of phosphorus, 4 mg of iron, 0.48 mg of vitamin B1, and 5 mg of vitamin C (Parwata, 2022). Recent phytochemical analyses have revealed that pigeon pea contains bioactive compounds including phenolic acids, flavonoids, and carotenoids that exhibit antioxidant and anti-inflammatory properties (Haji et al., 2024). Furthermore, pigeon pea has demonstrated hematological benefits in experimental models, with evidence suggesting its potential to accelerate hemoglobin recovery in bleeding conditions (Elhussain, 2020). Given the decline in hemoglobin levels after blood donation, an intervention is needed. Indonesia's natural resources, including *kacang undis*, are expected to help address this issue and enrich the variety of plants that may be beneficial as supplements or treatments for various conditions, particularly in increasing hemoglobin and hematocrit levels after blood donation.

Despite the nutritional potential of pigeon pea, limited research has evaluated its efficacy in clinical settings for post-blood donation recovery. Most existing studies on post-donation nutritional interventions focus on iron supplementation alone or synthetic formulations (Kiss et al., 2015; Mast et al., 2020). No prior studies have systematically examined the combined effects of *Undis Bean (Cajanus Cajan L.)* with iron-folic acid supplementation on hemoglobin and hematocrit recovery in blood donors. This study addresses this research gap by investigating whether the addition of processed pigeon pea to standard iron-folic acid supplementation enhances hematological recovery compared to iron-folic acid supplementation alone. The findings have practical implications for blood donation programs,

particularly in resource-limited settings where locally available, affordable nutritional interventions are needed to support donor health and retention.

RESEARCH METHOD

The study design is a clinical trial using a pretest–posttest control group design, in which participants will be divided into two groups: the first group received an iron–folic acid supplement, and the second group received processed *kacang undis* along with an iron–folic acid supplement.

The study population comprised blood donors who successfully completed donations at the Badung Regency Red Cross Mobile Unit during July 2024. Inclusion criteria included: (1) age 17-65 years; (2) successful completion of blood donation (350-500 mL); (3) hemoglobin levels within the eligible donation range (12.5-17 g/dL) at pre-donation screening; (4) willingness to participate in the study; and (5) no contraindications to iron supplementation or legume consumption. Exclusion criteria included: (1) chronic diseases affecting iron metabolism (e.g., thalassemia, hemochromatosis); (2) gastrointestinal disorders affecting nutrient absorption; (3) current use of medications interfering with iron absorption; (4) known allergy to legumes; and (5) pregnancy or lactation.

A total of 64 eligible donors were recruited using consecutive sampling technique and randomly allocated to two groups using computer-generated random numbers: control group (K, n=32) and treatment group (P, n=32). Sample size was calculated based on paired t-test requirements with α=0.05, power=80%, and expected effect size of 0.5, resulting in a minimum of 27 participants per group. The final sample of 32 per group provided adequate power while accounting for potential dropouts.

All participants received comprehensive information about the study objectives, procedures, and their right to withdraw at any time. Written informed consent was obtained from all participants prior to enrollment. Ethical approval was obtained from [Ethics Committee Name and Number to be inserted].

Baseline hemoglobin and hematocrit measurements were taken immediately after successful blood donation using the Photometric Point of Care Testing (POCT) method. The control group (K) received standard care consisting of one tablet of iron-folic acid (60 mg ferrous fumarate + 400 mcg folic acid) to be taken once daily for 7 days. The treatment group (P) received the same iron-folic acid supplementation plus 50 grams of processed pigeon pea daily for 7 days.

Processed pigeon pea was prepared using a standardized protocol: mature pigeon pea seeds were cleaned, soaked for 12 hours, boiled for 30 minutes until soft, and then seasoned with minimal salt. The 50-gram portion (measured after cooking) was packaged in standardized containers and distributed daily to treatment group participants. Participants were instructed to consume the processed pigeon pea with their main meal and take the iron-folic acid tablet 2 hours after eating to optimize absorption. Participants maintained dietary logs and were contacted daily via telephone to monitor compliance and adverse events.

On day 7 post-donation, all participants returned to the mobile unit for post-intervention hemoglobin and hematocrit measurements using the same POCT device and standard operating procedures. All measurements were performed by trained laboratory technicians blinded to

group allocation. Participants who failed to complete the 7-day intervention or missed the follow-up measurement were excluded from the final analysis.

Hemoglobin and hematocrit pretest–posttest data were analyzed statistically using SPSS version 25 with the following steps:

1. Descriptive statistical analysis to determine the characteristics of research subjects in each group.
2. Normality test using the Shapiro–Wilk test, because the sample size in each group is fewer than 50. The data are considered normally distributed if the p-value > 0.05.
3. Homogeneity test using Levene's test. The data are considered homogeneous if the p-value > 0.05.
4. Hypothesis testing for bivariate analysis between independent and dependent variables with continuous paired data using the paired t-test. If the assumptions for the paired t-test are not met, the Wilcoxon test will be used. If the p-value < 0.05, the null hypothesis is rejected, meaning there is a statistically significant difference.
5. Hypothesis testing for bivariate analysis between independent and dependent variables with continuous unpaired data in two groups using the independent t-test. If the assumptions for the independent t-test are not met, the Mann–Whitney test will be used. If the p-value < 0.05, the null hypothesis is rejected, indicating a statistically significant difference.

RESULT AND DISCUSSION

Analysis Descriptive Hemoglobin and Hematocrit

Analysis descriptive data results study covering mean and standard deviation (SD) on variables Hemoglobin and Hematocrit. Analysis results shown in table 6.

Table 1 Analysis Descriptive Variables Hemoglobin and Hematocrit

Variables	Group	
	Control n = 32 ($\bar{x}$ ± SD)	**Treatment n = 32 ($\bar{x}$ ± SD)**
Hemoglobin Pre	12,575 ±1,299	13,131 ±1,351
Hemoglobin Post	13,412 ±1,553	14,309 ±1,104
Delta Hemoglobin	0.837 ±0.539	1.178 ±0.572
Hematocrit Pre	36,406 ±3,892	38,250 ±4,087
Hematocrit Post	38,875 ±4,681	41,781 ±3,269
Delta Hematocrit	2,468 ±1,626	3,531 ±1,777

Average level Hemoglobin pretest found in the group control and group treatment is average 12,575 and 13,131 while average level Hemoglobin posttest in groups control and group treatment are 13,412 and 14,309. The average level Hematocrit pretest was obtained in the group control and group treatment is average 36,406 and 38,250 while average level Hematocrit posttest in groups control and group treatment is 38.875 and 41.781. The average delta Hemoglobin (posttest -pretest) group control and treatment are 0.837 and 1.178 while mean delta hematocrit group control and treatment are 2,468 and 3,531. There is difference average level hemoglobin by 0.341 gr/dl more high in the group treatment and there is difference average level hematocrit by 1,063% more high in the group treatment.

Data Normality Test

Hemoglobin and Hematocrit data results normality test was carried out with using the Shapiro -Wilk test. The results show that the data is normally distributed (p>0.05) in the group treatment and distribution abnormal in the group control, shown in Table 2.

Table 2 Normality Test of Hemoglobin and Hematocrit Data

Group Subject	n	p	Note
Hemoglobin pre K	32	0.019	Abnormal
Hemoglobin post K	32	0.024	Abnormal
Delta Hemoglobin K	32	0.004	Abnormal
Hemoglobin pre P	32	0.233	Normal
Hemoglobin post P	32	0.350	Normal
Delta Hemoglobin P	32	0.337	Normal
Hematocrit pre K	32	0.005	Abnormal
Hematocrit post K	32	0.012	Abnormal
Delta Hematocrit K	32	0.006	Abnormal
Hematocrit pre P	32	0.306	Normal
Hematocrit post P	32	0.193	Normal
Delta Hematocrit P	32	0.167	Normal

Hemoglobin and Hematocrit Levels

Hemoglobin Levels Before and After Treatment

For improvement level Hemoglobin between before and after treatment for each group, a comparison test was carried out with using the *Wilcoxon* test. The results of the analysis shown in Table 3.

Table 3Comparison of Hemoglobin Levels between Before and after Treatment

Group	n	Hemoglobin Pre ($\bar{x}$ ±(SD)	Hemoglobin Post ($\bar{x}$ ±SD)	P*
K	32	12,575 ±1,299	13,412 ±1,553	0,000*
P	32	13,131 ±1,351	14,309 ±1,104	0,000*
P**		0.104	0.028*	

Note: p* = Wilcoxon test; p** = Mann-Whitney test

Based on Table 3, it is obtained that in the group control (K) is present difference meaningful between before with after treatment namely p=0.000 (p<0.05) and in the group treatment (P) p=0.000 (p<0.05) exists difference meaningful level Hemoglobin between before with after treatment. Analysis average treatment before and after, levels hemoglobin tested with the Mann-Whitney test shown in Table 3. It was obtained results that before treatment No There is difference meaningful namely p=0.104 (p>0.05), whereas after treatment there is different significant p=0.028 (p<0.05).

Hematocrit Level Before and after Treatment

For know improvement Hemoglobin levels between before and after treatment for each group, a comparison test was carried out with using the *Wilcoxon* test. The results of the analysis shown in Table 4.

Table 4Comparison of Hematocrit Levels between Before and after Treatment

Group	n	Hematocrit Pre ($\bar{x}$ ±(SD)	Hematocrit Post ($\bar{x}$ ±(SD)	P*
K	32	36,406 ±3,892	38,875 ±4,681	0,000*
P	32	38,250 ±4,087	41,781 ±3,269	0,000*
P**		0.082	0.015*	

Note: p* = Wilcoxon test; p** = Mann-Whitney test

Based on Table 4, it is obtained that in the group control (P1) is present difference meaningful between before with after treatment namely p=0.000 (p<0.05) and in the group treatment (P2) p=0.000 (p<0.05) exists difference meaningful level Hematocrit between before with after treatment. Analysis average treatment before and after, levels Hematocrit tested with the Mann-Whitney test shown in Table 4. It was obtained results that before treatment No There is difference meaningful namely p=0.082 (p>0.05), whereas after treatment there is different significant p=0.015 (p<0.05).

The need for blood continues to increase along with the growing number of patients requiring transfusions. According to WHO, 1% of a country's population is needed to donate blood to meet national blood supply requirements (PMI, 2022). Individuals may donate blood if they are 17–65 years old, have hemoglobin levels of 12.5–17 g/dL, and meet the minimum donation interval of more than 8 weeks from the previous donation (PERMENKES, 2015). A donor will lose 350–500 mL of blood and approximately 200–250 mg of iron with each donation (Widiyawati et al., 2021). The body maintains blood volume in a balanced state (homeostasis), and new blood cell production occurs through erythropoiesis. Loss of iron after donation can lead to physiological changes such as fatigue, reduced exercise capacity, impaired attention, and decreased learning and memory function (Urbina, 2022).

Donors generally receive iron and folic acid supplementation after blood donation. However, donors with iron deficiency who receive iron–folate supplementation may still experience relative anemia even 120 days after donating. Meanwhile, donors with normal hemoglobin levels may require more than 168 days to recover their pre-donation ferritin levels if they do not take supplementation (Kiss et al., 2015).

Hemoglobin and hematocrit are two important indicators used to evaluate blood volume in the body. Measurement of hemoglobin and hematocrit is typically performed before donation, and post-donation evaluation is rarely conducted. A significant decrease in hemoglobin levels after blood donation has been reported, which is a physiological response to blood loss; however, it is important to consider the recovery time needed for hemoglobin levels to return to normal (Nittymaki, 2017). Hematocrit is the percentage of erythrocyte volume per milliliter of blood, and its level varies depending on an individual's condition. Blood loss, anemia, physical activity, and high altitude can reduce hematocrit levels (Guyton & Hall, 2019). In hypoxic conditions, the body increases red blood cell production, resulting in elevated hematocrit; however, excessively high hematocrit will increase blood viscosity (Kishimoto, 2020).

Iron is required for red blood cell formation. Iron supplementation is provided when the body lacks iron, during malabsorption, chronic inflammation, blood loss, or increased iron demand (Nguyen, 2023). Iron compounds can be found in natural ingredients such as legumes, including kacang undis. Kacang undis contains various active compounds that may increase

iron levels and improve blood volume. Extracts of kacang undis have been shown to increase hemoglobin levels at a dose of 200 mg/kg BW, with average hemoglobin rising from 9.6 g/dL to 13.2 g/dL (Elhussain, 2020).

The Effects of Blood Donation

In this study, donors who completed a blood donation lost approximately 350 mL of blood. Other studies have reported that donors lose around 200 mg of iron with each donation (Widiyawati et al., 2021). Blood loss may cause symptoms such as sweating, pallor, dizziness, nausea, vomiting, malaise, rapid shortness of breath, decreased consciousness, and even seizures (Amalia, 2019).

In the present research, among 64 respondents, 3 individuals (4.5%) experienced post-donation complaints, with dizziness being the only symptom reported. This study found a decrease in hemoglobin levels in the control group from 14.325 g/dL to 12.575 g/dL, and in the treatment group from 14.681 g/dL to 13.131 g/dL. A decrease in hematocrit levels was also observed: in the control group from 41.906% to 36.406%, and in the treatment group from 42.875% to 38.250%.

The decline in hemoglobin and hematocrit levels in the control group was 1.75 g/dL (12.2%) and 5.4% (12.9%), respectively. In the treatment group, the decrease was 1.55 g/dL (10.6%) and 4.6% (10.8%). Statistical tests showed no significant difference between the two groups. Amalia's study reported a decrease in hemoglobin after blood donation from an average of 14.84 g/dL to 12.63 g/dL, a reduction of 2.21 g/dL (14.8%). Differences in the magnitude of decline may be attributed to variations in age and body weight (Amalia, 2019).

The Influence of Processed *Kacang Undis* (Cajanus cajan L.) and Iron–Folic Acid Supplementation on Hemoglobin Levels After Blood Donation

This study was conducted to determine the effect of processed *kacang undis* (Cajanus cajan L.) combined with iron–folic acid supplementation on post-donation hemoglobin improvement. Participants were divided into two groups:

a. Control group: received iron–folic acid supplements only.
b. Treatment group: received iron–folic acid supplements and 50 grams of processed *kacang undis* daily for 7 days.

Statistical analysis using the Wilcoxon non-parametric test showed that administering 1 tablet of iron–folic acid per day and providing 50 grams of processed *kacang undis* significantly increased hemoglobin levels ($p = 0.000$). The Mann–Whitney test comparing both groups in the posttest phase showed a significant increase in hemoglobin levels in the treatment group ($p < 0.028$). These results demonstrate that processed *kacang undis* combined with iron–folic acid supplementation effectively improves hemoglobin levels after blood donation.

Based on proximate and micronutrient analysis conducted at the Saraswanti Indo Genetech (SIG) Laboratory in Surabaya, processed *kacang undis* contains per 100 g:

a. Energy from Fat (Simplo; Duplo): 23.40; 23.13 Kcal
b. Total Fat: 2.60%; 2.57%
c. Total Energy: 349.48; 349.85 Kcal
d. Carbohydrates: 59.82%; 60.25%
e. Protein: 21.70%; 21.43%

f. Iron: 6.07; 5.22 mg
g. Folic Acid (B9): Not detected (Detection limit 50.00)

Previous studies by Parwata and Abebe reported fat content of 1.40–1.49 g, carbohydrates 62–62.78 g, protein 20.7–21.7 g, and iron content 4–5.23 mg. These values do not show significant differences compared to the results obtained in the present study (Parwata, 2022; Abebe, 2022).

Nutritional Content of *Kacang Undis*

The nutritional contents of *kacang undis* consist of carbohydrates, proteins, fats, iron, and amino acids, making it a nutritional food source. *Kacang undis* can be utilized from its leaves, roots, and seeds, all of which contain phenolic compounds that have anti-inflammatory, antibacterial, antioxidant, anticarcinogenic, and antidiabetic properties. The main carbohydrates in *kacang undis* are soluble sugars, starch, and fiber. The soluble sugar content ranges from 33.23–60.80 mg/g. The starch content in raw and cooked *kacang undis* ranges from 272.70–521.28 mg/g. Soluble and insoluble fibers in the roots are 21.8 g/100 g and 19.4 g/100 g, respectively (Abebe, 2022).

According to Elhussain's study, administration of *kacang undis* extract can increase hemoglobin levels in bleeding conditions, reducing recovery time from 3 weeks to 1 week when given at a dose of 200 mg/kg BW. *Kacang undis* extract has anti-inflammatory effects because its cyanidin-3-monoglucoside content decreases inflammatory cytokines—including TNF-α, IL-1β, and IL-6—in macrophages. The reduction of inflammatory cytokines helps reduce the breakdown of red blood cells (Elhussain, 2020).

Research by Thi Vo et al. found no significant differences in hematological analysis after giving *kacang undis* root extract. Differences in this finding are due to variations in the plant parts used (seeds vs. roots) and the absence of prior blood loss in experimental animals. Meanwhile, both this study and Elhussain's study examined conditions involving prior blood loss (Thi Vo et al., 2023).

In Mast's study, administration of iron supplements reduced red blood cell recovery time in individuals with ferritin levels below 50 ng/mL. Iron supplementation shortened recovery time from more than 30 days (without supplementation) to approximately 13 days. Iron supplementation also increased hepcidin recovery in donors with ferritin levels ≥ 12 ng/mL, where hepcidin functions to regulate iron homeostasis (Mast et al., 2020).

Hemoglobin levels are strongly influenced by adequate nutritional intake to support proper blood cell formation. Iron, as the main component of hemoglobin synthesis, must be available in sufficient amounts. With 60 mg of ferrous fumarate and an additional 5.22–6.07 mg of iron from *kacang undis*, the body's iron needs can be fulfilled. The recommended dietary allowance (RDA) for iron in adults aged 19–49 years is 18 mg. The macronutrient test of processed *kacang undis* did not detect folic acid content. The RDA for folic acid is 400 mcg for individuals over 10 years old, and participants already met folate requirements from supplementation. Folic acid is essential during the final maturation of red blood cell formation (Ministry of Health Regulation, 2019).

Influence of Processed *Kacang Undis* (Cajanus cajan L.) and Iron–Folic Acid Supplementation on Hematocrit Levels After Blood Donation

This study aimed to determine the effect of processed *kacang undis* (*Cajanus cajan L.*) combined with iron–folic acid supplementation on hematocrit improvement after blood donation. Participants were divided into two groups: the control group, which received iron–folic acid supplements, and the treatment group, which received 1 tablet of iron–folic acid per day along with 50 grams of processed *kacang undis* for 7 days.

The Wilcoxon non-parametric statistical test showed that supplementation with iron–folic acid combined with 50 grams of processed *kacang undis* significantly increased hematocrit levels. The Mann–Whitney analysis comparing both groups in the posttest phase revealed a significant difference, with $p < 0.015$, indicating a meaningful increase in the treatment group. These results demonstrate the effect of processed *kacang undis* and iron–folic acid supplementation on hematocrit improvement after blood donation.

Normal hematocrit levels differ by gender: 37–47% in women and 40–45% in men. By age category, normal levels include 32–44% (3 months), 36–44% (3–6 years), and 37–45% (10–12 years). A decrease in hematocrit occurs after blood donation as the body loses blood volume. The body will then attempt to maintain homeostasis. Respondents who received adequate post-donation nutrition experienced an improvement in blood volume.

In the study by Nafsi and Sofyanita, hematocrit levels among donors declined from 43.3% to 40.2% after blood donation. Low post-donation hematocrit levels were more common among male respondents (7 individuals) and adults aged 25–44 years (4 individuals) (Nafsi & Sofyanita, 2023). In the present study, hematocrit levels returned to pre-donation levels after administration of iron–folic acid supplements and processed *kacang undis*. Hematocrit decreases post-donation due to loss of blood and nutritional components, especially blood volume. Donors may lose up to 350 mL of blood, or about 10% of their total blood volume, resulting in reduced hematocrit. In anemia, hematocrit levels naturally decline.

CONCLUSION

This study concludes that combining iron-folic acid supplementation with processed *kacang undis* (*Cajanus cajan* L.) effectively elevates hemoglobin and hematocrit levels post-blood donation, outperforming iron-folic acid alone, with significant differences observed between the treatment group (processed *kacang undis* plus supplementation) and the control group (supplementation only), highlighting the additive benefits of *kacang undis* in restoring hematological parameters. For future research, longitudinal studies could evaluate the long-term effects of this intervention on donor retention rates, iron stores (e.g., ferritin levels), and overall health outcomes in diverse populations, including frequent donors and those in varying nutritional contexts.

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