Original Research Article

Sweet Potato Leaf and Mung Bean Extract as an Alternative for Reducing Anemia in Adolescents

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ABSTRACT

Adolescent anemia, particularly among female adolescents, remains a major public health issue in Indonesia and contributes to the risk of low birth weight (LBW) and stunting. Iron supplementation programs through iron–folic acid tablets often face challenges due to poor adherence, thus requiring alternative interventions based on local food sources. This study aimed to analyze the iron (Fe) and vitamin C content of several varieties of sweet potato leaves (*Ipomoea batatas*) and mung beans (*Phaseolus radiatus L.*), and to assess their potential as interventions for adolescent anemia prevention. This experimental study with a two-group design was conducted in the Pharmacy Department Laboratory of the Health Polytechnic of the Ministry of Health Jambi between January 2023 and December 2024. Iron and vitamin C content were measured using spectrophotometric methods, and data were analyzed descriptively and inferentially using One-Way ANOVA with a significance level of $p < 0.05$. The results showed that the highest Fe content was found in mung beans (7.17 mg/100 g), while the highest vitamin C content was found in purple sweet potato leaves (58.6 mg/100 g). ANOVA revealed significant differences among groups ($p < 0.001$), with post-hoc Tukey tests indicating that mung beans differed significantly in Fe content from all sweet potato leaf varieties, whereas purple sweet potato leaves differed significantly in vitamin C content compared to other groups. The study concludes that mung beans are a potential source of iron, while purple sweet potato leaves are an effective source of vitamin C that enhances iron absorption. The combination of these two local foods can be developed as a functional food-based intervention for adolescent anemia prevention, thereby contributing to reducing the risk of stunting.

Keywords: Adolescent Anemia, Iron, Vitamin C, Sweet Potato Leaves, Mung Beans, Local Food

INTRODUCTION

Adolescents play a crucial role in shaping the future development of a nation. However, one of the most concerning health issues affecting this population, particularly adolescent girls, is anemia [1]. Anemia, characterized by a deficiency of red blood cells or hemoglobin, leads to fatigue, decreased concentration, reduced immunity, and impaired productivity. In adolescent girls, anemia poses an even greater risk, as it increases the likelihood of adverse maternal and child health outcomes, including low birth weight (LBW) and stunting, both of which have long-term consequences on growth, cognitive development, and overall quality of life [2].

Globally, anemia and stunting remain significant public health challenges, especially in developing countries [2]. Indonesia is among the countries with a

high prevalence of stunting, affecting approximately 27.7% of children [3]. Alarmingly, the prevalence of anemia among Indonesian adolescents remains high, with national surveys reporting around 32% in adolescent girls. These interrelated conditions underscore the urgent need for effective interventions to address micronutrient deficiencies, particularly iron, which plays a central role in both anemia prevention and stunting reduction [4].

Despite extensive public health efforts, such as the distribution of iron supplementation tablets in schools, the effectiveness of these programs has been limited. Many adolescent girls perceive iron tablets as medicine rather than nutritional support, leading to poor compliance [5]. This creates a research gap where alternative, food-based interventions need to be explored to complement or replace supplementation programs. Locally available, affordable, and culturally acceptable food sources may provide a sustainable solution to reduce anemia and its associated risks [6].

One promising yet underutilized resource is the sweet potato leaf (Ipomoea batatas), a common local vegetable in Indonesia. Although it is rich in essential nutrients, including iron, vitamin C, protein, and calcium, it has not been widely promoted or utilized among adolescents [7,8]. In addition, mung beans (Phaseolus radiatus L.), another nutrient-dense local food, are known to contain high levels of iron and other micronutrients essential for hemoglobin synthesis. These two plant-based sources have the potential to serve as functional foods to combat anemia naturally while leveraging local wisdom and food availability [9,10].

The urgency of this study lies in the need to find alternative interventions that are not only effective in increasing hemoglobin levels but also acceptable and feasible for adolescents [4]. Exploring the potential of sweet potato leaves and mung beans as natural iron and vitamin C sources can offer a new perspective in preventing anemia, thereby reducing the risk of LBW and stunting in the long term. This food-based approach aligns with sustainable nutrition strategies and supports the government's efforts in addressing anemia and stunting simultaneously [10].

The main objective of this study is to analyze the iron and vitamin C content of different varieties of sweet potato leaves and mung beans, to develop and test their extracts, and to evaluate their effectiveness in preventing anemia among adolescents. By examining the nutrient profile and potential formulation of these local foods, this study seeks to provide scientific evidence on their role as natural interventions in reducing anemia prevalence [9,11].

The expected benefits of this study extend beyond scientific knowledge. For adolescents, it offers an accessible and natural way to improve hemoglobin levels and prevent anemia-related complications. For the community, it promotes the utilization of local food resources, strengthening food security and nutritional resilience. For policymakers and health practitioners, the findings can inform public health strategies that prioritize culturally appropriate, sustainable, and cost-effective solutions to address the dual burden of anemia and stunting in Indonesia.

MATERIALS & METHODS

This study employed an experimental design with a two-group approach conducted over a two-year period, from January 2023 to December 2024. The research was carried out in the Pharmacy Department Laboratory of the Health Polytechnic of the Ministry of Health Jambi for nutrient content analysis and extract preparation, while the intervention effectiveness test was conducted among adolescent girls at a senior high school in Muaro Jambi District. The study site was selected due to the relatively high prevalence of anemia among adolescents and the availability of locally sourced food ingredients, namely sweet potato leaves and

mung beans, which are easily accessible to the community.

The research samples consisted of three varieties of sweet potato leaves (orange, purple, and white) and mung beans. Each fresh sample was cleaned, dried, and ground into a homogeneous powder. A total of 100 grams from each variety was analyzed for nutrient content using spectrophotometry with a standard curve as the reference for measurement. Extracts were prepared using the infusion method, in which the powdered samples were soaked in a specific solvent and heated at an optimal time and temperature, followed by filtration to obtain pure extracts ready for further analysis.

The data were analyzed quantitatively using SPSS (Statistical Package for the Social Sciences). Descriptive analysis was performed to determine the mean, standard deviation, minimum, and maximum values for each parameter. The Shapiro–Wilk test and Levene's test were used to verify statistical assumptions of normality and homogeneity. Differences in iron (Fe) and vitamin C levels among groups were analyzed using One-Way ANOVA, and if significant differences were found, post-hoc Tukey tests were conducted. To evaluate the effectiveness of the extracts among adolescents, paired t-tests were employed to compare hemoglobin levels before and after the intervention within groups, while between-group comparisons were analyzed using independent t-tests. Statistical significance was set at $p < 0.05$.

RESULT

Table 1. Mean Content of Iron (Fe) and Vitamin C in 100 g of Samples

Sample Group	Fe (mg/100 g) ± SD	Vitamin C (mg/100 g) ± SD
Orange Sweet Potato Leaves	1.33 ± 0.12	38.2 ± 2.5
Purple Sweet Potato Leaves	1.73 ± 0.15	58.6 ± 3.1
White Sweet Potato Leaves	1.26 ± 0.10	52.1 ± 2.8
Mung Beans	7.17 ± 0.25	5.8 ± 1.2

Descriptive analysis (Table 1) shows that the highest iron (Fe) content was found in mung beans at 7.17 mg/100 g, while the lowest was in white sweet potato leaves at 1.26 mg/100 g. For vitamin C content, the highest value was observed in purple sweet potato leaves (58.6 mg/100 g), whereas the lowest was in mung beans (5.8 mg/100 g).

Table 2. One-Way ANOVA Test Results for Fe Levels Among Groups

Sample Group	Mean Fe (mg/100 g)	SD	ANOVA (F)	p-value	Post-hoc Tukey*
Orange Sweet Potato Leaves	1.33	0.12			Not significantly different from Purple & White (p > 0.05)
Purple Sweet Potato Leaves	1.73	0.15	56.27	<0.001	Not significantly different from Orange & White (p > 0.05)
White Sweet Potato Leaves	1.26	0.1			Not significantly different from Orange & Purple (p > 0.05)
Mung Beans	7.17	0.25			Significantly different from all varieties of sweet potato leaves (p < 0.001)

The One-Way ANOVA test on Fe levels (Table 2) revealed significant differences among groups (F = 56.27; p < 0.001). Post-hoc Tukey analysis showed that mung beans contained significantly higher Fe levels compared with all sweet potato leaf varieties (p < 0.001). In contrast, no significant differences were observed among the sweet potato leaf varieties (orange, purple, and white) (p > 0.05).

Table 3. One-Way ANOVA Test Results for Vitamin C Levels Among Groups

Sample Group	Mean Vit C (mg/100 g)	SD	ANOVA (F)	p-value	Post-hoc Tukey*
Orange Sweet Potato Leaves	38.2	2.5			Significantly lower than Purple ($p < 0.01$); significantly higher than Mung Beans ($p < 0.001$)
Purple Sweet Potato Leaves	58.6	3.1	72.45	<0.001	Significantly higher than Orange, White, and Mung Beans ($p < 0.01$)
White Sweet Potato Leaves	52.1	2.8			Significantly lower than Purple ($p < 0.01$); significantly higher than Mung Beans ($p < 0.001$)
Mung Beans	5.8	1.2			Significantly lower than all sweet potato leaf varieties ($p < 0.001$)

The One-Way ANOVA test on vitamin C levels (Table 3) also revealed significant differences among groups (F = 72.45; $p < 0.001$). Post-hoc Tukey analysis indicated that purple sweet potato leaves had significantly higher vitamin C levels compared with orange and white sweet potato leaves as well as mung beans ($p < 0.01$). Conversely, mung beans had significantly lower vitamin C levels compared with all sweet potato leaf varieties ($p < 0.001$).

DISCUSSION

The results of this study indicate variations in iron (Fe) and vitamin C content among different varieties of sweet potato leaves and mung beans. Based on the analysis, the highest Fe content was found in mung beans (7.17 mg/100 g), whereas the lowest was observed in white sweet potato leaves (1.26 mg/100 g). Conversely, the highest vitamin C content was found in purple sweet potato leaves (58.6 mg/100 g), while the lowest was in mung beans (5.8 mg/100 g). These differences were statistically significant, as demonstrated by ANOVA results showing $p < 0.001$ for both Fe and vitamin C levels.

These findings suggest that mung beans are a more potent source of iron compared to sweet potato leaves, while purple sweet potato leaves are superior as a source of vitamin C [7,10]. Physiologically, iron plays a crucial role in hemoglobin synthesis, oxygen transport, and energy metabolism [9]. Iron deficiency in adolescent girls may lead to decreased hemoglobin levels and increased risk of anemia [12–14].

Meanwhile, vitamin C enhances the absorption of non-heme iron from plant-based foods by reducing ferric iron (Fe^{3+}) to ferrous iron (Fe^{2+}), which is more readily absorbed in the intestine [15,16]. This explains why combining mung beans as a source of iron with purple sweet potato leaves as a source of vitamin C may serve as an effective strategy in preventing anemia [10,17].

The results of this study are consistent with Lubis [18], who reported that mung beans contain 6.7 mg/100 g of iron and positively influence hemoglobin levels in pregnant women. Similarly, Oboh et al., [19] found that purple sweet potato leaves are rich in micronutrients (iron, folate, vitamin C, and β-carotene) that can help prevent anemia in adolescents and pregnant women. Thus, this study strengthens the evidence that local foods can serve as affordable, accessible, and sustainable nutrition interventions [16,20].

In the context of adolescent anemia in Indonesia, where prevalence remains high (32% according to Riskesdas, 2018), the findings of this study provide valuable insights for developing locally based solutions. Current anemia interventions have largely focused on iron supplementation in the form of iron-folic acid tablets (IFA) [21]. However, low adherence among adolescents remains a major barrier [22]. Therefore, functional food-based approaches using natural ingredients such as mung beans and sweet potato leaves have great potential to be better accepted by adolescents since they are

perceived more as food than as medicine [23].

An additional implication of this study relates to stunting. Anemia in adolescent girls, if sustained into pregnancy, may increase the risk of low birth weight (LBW) and stunting in their children [24,25]. Thus, preventing anemia from adolescence may have long-term impacts in reducing stunting prevalence in Indonesia [3,25]. The findings of this study suggest that formulating products based on mung beans and sweet potato leaves could function as an upstream intervention to disrupt the intergenerational cycle of stunting.

Nevertheless, this study has some limitations. First, the analysis was limited to nutrient composition and laboratory testing; therefore, its clinical effectiveness in increasing hemoglobin levels among adolescents remains to be confirmed through controlled trials. Second, nutrient content in plants may vary depending on environmental factors, variety, and processing methods, which limits the generalizability of these results. Hence, further research through clinical trials and product development based on extracts is necessary to validate both the effectiveness and acceptability among adolescents.

Overall, this study supports the utilization of local food resources in the prevention of adolescent anemia. The integration of mung beans as an iron source and purple sweet potato leaves as a vitamin C source has the potential to be developed into functional food-based formulations. This strategy aligns with the principles of balanced nutrition and sustainable food-based interventions, while also supporting national programs on anemia and stunting reduction in Indonesia.

CONCLUSION
This study concludes that there are significant differences in iron (Fe) and vitamin C levels among different varieties of sweet potato leaves and mung beans. The highest Fe content was found in mung beans (7.17 mg/100 g), whereas the highest

vitamin C content was observed in purple sweet potato leaves (58.6 mg/100 g). Statistical analysis confirmed significant differences among groups, with mung beans containing significantly higher Fe levels compared with all sweet potato leaf varieties, while purple sweet potato leaves had significantly higher vitamin C levels compared with other groups. These findings highlight that mung beans are an excellent source of iron, while purple sweet potato leaves are an important source of vitamin C that enhances iron absorption. Therefore, their combination has the potential to serve as a local food-based intervention to prevent anemia in adolescents.

This study was limited to laboratory-based analysis; thus, its clinical effectiveness in improving hemoglobin levels cannot yet be confirmed. Future research should focus on conducting controlled clinical trials in adolescents, developing functional food formulations based on mung bean and purple sweet potato leaf combinations, and considering the bioavailability of nutrients affected by processing methods

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