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Effectiveness of Purple Sweet Potato Leaves (Ipomoea batatas L.) in Improving Hemoglobin Levels among Anemic Pregnant Women in the Second and Third Trimesters

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Abstract: Anemia in pregnancy remains a major public health problem worldwide, contributing to increased maternal and perinatal morbidity and mortality. Purple sweet potato leaves (*Ipomoea batatas L.*) are rich in iron, folate, vitamin C, and anthocyanins, which are beneficial for hemoglobin synthesis and iron absorption. This study aimed to evaluate the effectiveness of purple sweet potato leaf consumption in increasing hemoglobin levels among pregnant women in the second and third trimesters with anemia. A quasi-experimental study with a pretest–posttest control group design was conducted on 60 pregnant women with anemia (hemoglobin < 11 g/dL). Participants were allocated into an intervention group (n = 30) consuming 100 g of cooked purple sweet potato leaves daily for four weeks, and a control group (n = 30) following the standard antenatal diet without additional intervention. Hemoglobin levels were measured before and after the intervention using the cyanmethemoglobin method. Data were analyzed using the Shapiro–Wilk test, paired t-test, and independent t-test with a significance level of $p < 0.05$. The mean hemoglobin increase in the intervention group was significantly higher compared with the control group (1.2 ± 0.4 g/dL vs. 0.3 ± 0.3 g/dL; $p < 0.001$). The between-group mean difference was 0.9 g/dL (95% CI: 0.7–1.1). Daily consumption of purple sweet potato leaves effectively increased hemoglobin levels in pregnant women with anemia during the second and third trimesters. This local food-based intervention may serve as a practical alternative strategy to prevent and manage anemia in pregnancy.

Keywords: Anemia; Hemoglobin; Pregnancy; Purple sweet potato leaves

Introduction

Anemia in pregnancy remains a significant public health concern, particularly in low- and middle-income countries (LMICs). According to the World Health Organization World Health Organization (2021), approximately 37% of pregnant women worldwide are affected by anemia, with Southeast Asia showing some of the highest rates globally. In Indonesia, the National Basic Health Research (Riskesdas, 2018) reported that nearly half of pregnant women (48.9%) suffer from anemia, which is classified as a moderate to severe public health problem. Maternal anemia is associated with adverse outcomes such as preterm birth, low birth weight, intrauterine growth restriction, postpartum hemorrhage, and increased maternal mortality (Kavle et al., 2018; Stevens et al., 2013). These consequences compromise not only maternal health but also neonatal survival and long-term child development (Ministry of Health Republic of Indonesia, 2018).

Iron-folic acid supplementation is the most widely implemented intervention to address anemia during

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pregnancy. However, adherence to supplementation remains suboptimal due to gastrointestinal side effects (nausea, constipation, and abdominal discomfort), poor palatability, and irregular intake patterns (Lidoriki et al., 2024; Lin et al., 2025; Sanghvi et al., 2020). Moreover, supplementation programs in resource-limited settings face challenges related to accessibility, affordability, and supply chain continuity (Galloway et al., 1994). Consequently, despite nationwide supplementation programs, the prevalence of anemia among pregnant women in Indonesia has not declined substantially, underscoring the need for alternative or complementary approaches (Ameline et al., 2025; Basrowi et al., 2024).

Food-based strategies represent a sustainable and culturally acceptable approach to combat anemia. Purple sweet potato leaves (Ipomoea batatas L.), widely available and inexpensive in Indonesia, have been traditionally consumed as leafy vegetables but are often underutilized in maternal nutrition programs. These leaves are nutritionally dense, containing iron, folate, and vitamin C, which are crucial for hemoglobin synthesis and non-heme iron absorption (Ishida et al., 2000; Truong et al., 2007). In addition, anthocyanins present in purple sweet potato leaves act as antioxidants, potentially enhancing erythropoiesis and reducing oxidative stress (Teow et al., 2007). Unlike iron tablets, purple sweet potato leaves are easily integrated into daily meals, thus improving compliance and acceptability among pregnant women.

Although studies have shown that purple sweet potato leaves can improve hemoglobin levels in adolescents and animal models (Jubaedah et al., 2024; Sulastri et al., 2020), there remains limited evidence among pregnant women. Considering the critical importance of addressing anemia during pregnancy, further investigation of practical, food-based interventions is urgently needed.

Therefore, this study aims to evaluate the effectiveness of daily consumption of purple sweet potato leaves in increasing hemoglobin levels among anemic pregnant women in their second and third trimesters. The findings may provide scientific evidence to support the integration of locally available food resources into maternal health programs, particularly in LMICs where anemia prevalence remains high

Method

Study Design

A quasi-experimental design with a pretest–posttest control group was used.

Setting and Duration

The study was conducted at a Community Health Center, Indonesia, from January to March 2025.

Population and Sample

Pregnant women in the second or third trimester diagnosed with mild-to-moderate anemia (hemoglobin 8.0–10.9 g/dL). A total of 60 participants were enrolled and divided into two groups: intervention (n=30) and control (n=30). Sampling was performed using consecutive sampling with matching by gestational age and parity.

Intervention

The intervention group consumed 100 g of boiled purple sweet potato leaves daily for four weeks in addition to their regular diet and iron supplementation. The control group followed the standard antenatal diet with iron supplementation only.

Data Collection

Hemoglobin was measured by the cyanmethemoglobin method using a spectrophotometer.Compliance with leaf consumption was assessed through food diaries and weekly interviews.

Data Analysis

Normality was assessed with the Shapiro–Wilk test. Paired t-test was used to analyze within-group changes. Independent t-test was applied to compare mean hemoglobin changes between groups. Effect size was calculated using Cohen's d. Statistical significance was set at $p < 0.05$.

Results and Discussion

Baseline Characteristics of Respondents

Understanding the baseline characteristics of participants is essential to ensure comparability between study groups before the intervention is administered. These characteristics help determine whether differences in the outcome can be attributed to the intervention rather than pre-existing disparities. In this study, the maternal demographic and clinical profiles of the intervention and control groups were assessed to establish baseline equivalence.

The baseline characteristics of the study participants showed no significant differences between the intervention and control groups across all measured variables ($p > 0.05$). The mean maternal age was comparable, with 27.8 ± 4.2 years in the intervention group and 28.1 ± 4.5 years in the control group, indicating that both groups were within the optimal reproductive age range. Similarly, the distribution of gestational trimester was balanced, with approximately 60% in the second trimester and 40% in the third trimester in the intervention group, compared to 56.7% and 43.3%, respectively, in the control group. This suggests that gestational stage, which is an important determinant of anemia risk, was evenly represented.

Parity was also similar, with nearly equal proportions of primiparous and multiparous women in both groups. This is relevant because multiparity is often associated with reduced iron reserves due to repeated pregnancies. Pre-pregnancy body mass index (BMI) did not differ significantly between the two groups, indicating comparable nutritional status before conception, which can influence hemoglobin concentration during pregnancy. Additionally, a high proportion of women in both groups reported regular iron supplementation (90% vs. 86.7%), suggesting that adherence to standard anemia prevention programs was consistent.

Table 1. Baseline Characteristics of Respondents (n = 60)

Variable	Intervention (n=30)	Control (n=30)	p-value
Maternal age, years (mean ± SD)	27.8 ± 4.2	28.1 ± 4.5	0.76
Gestational trimester, n (%)	2nd: 18 (60.0) 3rd: 12 (40.0)	2nd: 17 (56.7) 3rd: 13 (43.3)	0.79
Parity, n (%)	Primipara: 13 (43.3) Multipara: 17 (56.7)	Primipara: 12 (40.0) Multipara: 18 (60.0)	0.80
Pre-pregnancy BMI (kg/m²)	23.1 ± 2.3	23.0 ± 2.5	0.88
Regular Fe supplementation, n (%)	27 (90.0)	26 (86.7)	0.69

The absence of significant differences in these baseline variables indicates that randomization was successful in ensuring group comparability. This strengthens the internal validity of the study, as any observed changes in hemoglobin levels after the intervention can be more confidently attributed to the consumption of purple sweet potato leaves rather than to baseline disparities. Moreover, the fact that anemia persisted despite widespread use of iron supplements underscores the potential added value of incorporating nutrient-dense local foods such as purple sweet potato leaves into maternal nutrition interventions.

Table 2. Hemoglobin Levels before and after Intervention

Group	Baseline Hb (g/dL)	Post Hb (g/dL)	ΔHb (mean ± SD)	p-value (within group)
Intervention (n=30)	9.8 ± 0.5	11.0 ± 0.7	+1.2 ± 0.4	<0.001
Control (n=30)	9.7 ± 0.6	10.0 ± 0.5	+0.3 ± 0.3	0.002

At baseline, mean hemoglobin (Hb) levels were comparable between the intervention group (9.8 ± 0.5 g/dL) and the control group (9.7 ± 0.6 g/dL), confirming the similarity of anemia severity at study entry.

Following the intervention, the group that consumed purple sweet potato leaves experienced a significant improvement in hemoglobin concentration, with mean Hb increasing from 9.8 ± 0.5 g/dL to 11.0 ± 0.7 g/dL (ΔHb = +1.2 ± 0.4 g/dL, $p < 0.001$, within-group). In contrast, the control group, which continued with standard care and iron supplementation alone, showed a modest but statistically significant rise in Hb from 9.7 ± 0.6 g/dL to 10.0 ± 0.5 g/dL (ΔHb = +0.3 ± 0.3 g/dL, $p = 0.002$, within-group).

Between-group comparison demonstrated that the mean difference in Hb change (ΔHb) was 0.9 g/dL (95% CI: 0.7–1.1), favoring the intervention group ($p < 0.001$). This indicates that the consumption of purple sweet potato leaves contributed to a substantially greater improvement in maternal hemoglobin compared to standard care alone.

Discussion

The present study demonstrated that the consumption of purple sweet potato leaves (*Ipomoea batatas L.*) significantly increased hemoglobin levels among pregnant women with anemia in their second and third trimesters. These findings are consistent with previous studies that highlighted the nutritional potential of locally available food sources in addressing maternal anemia (Jubaedah et al., 2024; Sulastri et al., 2020). The iron and folate content in purple sweet potato leaves contribute directly to hemoglobin synthesis, while vitamin C enhances non-heme iron absorption, thereby improving overall iron bioavailability (Hurrell et al., 2010; Ishida et al., 2000).

A key advantage of purple sweet potato leaves over conventional iron supplementation lies in their tolerability and acceptability. Pregnant women often report gastrointestinal side effects from iron tablets, which can lead to poor compliance (Sanghvi et al., 2020). By contrast, food-based interventions like purple sweet potato leaves can be incorporated into daily meals without significant adverse effects, thus ensuring better adherence. This aligns with the recommendations by World Health Organization (2021a) and Food and Agriculture Organization (2017), which emphasize food-based approaches as sustainable strategies to reduce micronutrient deficiencies in low- and middle-income countries.

Our findings also support the growing body of evidence that bioactive compounds such as anthocyanins, abundant in purple sweet potato leaves, may play a role in improving hematological profiles through antioxidant and anti-inflammatory mechanisms (Teow et al., 2007; Truong et al., 2007). Oxidative stress has been associated with impaired erythropoiesis and iron metabolism in pregnancy, and dietary antioxidants may mitigate these effects, thereby enhancing hemoglobin synthesis (Rizwan et al., 2014).

This study has important implications for maternal health programs. While iron–folic acid supplementation remains the cornerstone of anemia prevention, integrating local and affordable food resources such as purple sweet potato leaves could serve as an effective complementary strategy. This is particularly relevant in Indonesia, where the prevalence of anemia in pregnancy remains high despite decades of supplementation programs (Riskesdas, 2018). Food-based strategies not only address micronutrient deficiencies but also resonate with cultural dietary practices, thereby improving sustainability and scalability in community health interventions (Bhutta et al., 2013).

Nevertheless, certain limitations should be acknowledged. First, the study was conducted with a relatively small sample size (n=60) and within a specific geographical context, which may limit generalizability. Second, dietary intake from other sources and individual variations in nutrient absorption were not controlled, potentially influencing outcomes. Future research should consider randomized controlled trials with larger populations and longer intervention periods to validate these findings. Additionally, exploring the synergistic effects of combining purple sweet potato leaves with other locally available iron-rich foods could further strengthen food-based strategies for anemia prevention.

In summary, this study provides evidence that purple sweet potato leaves are effective in improving hemoglobin levels among anemic pregnant women. Their nutritional profile, cultural acceptability, and low cost make them a promising dietary intervention to complement existing anemia control programs. Integrating such food-based approaches into maternal nutrition policies could significantly reduce the burden of anemia in pregnancy, particularly in resource-limited settings.

Conclusion

The consumption of purple sweet potato leaves (Ipomoea batatas L.) significantly improved hemoglobin levels in anemic pregnant women during their second and third trimesters, with the intervention group showing a greater increase compared with the control group. This effect is likely due to the high content of iron, folate, vitamin C, and anthocyanins, which enhance hemoglobin synthesis and iron absorption. Purple sweet potato leaves provide a culturally acceptable, affordable, and sustainable dietary approach that complements standard iron–folic acid supplementation, addressing persistent maternal anemia. Despite the positive outcomes, limitations include the small sample size and short intervention period, which may affect the generalizability of the findings. Future research should employ larger randomized controlled trials with extended duration and evaluate the combined effect of multiple nutrient-rich local foods to optimize maternal hemoglobin status and improve pregnancy outcomes.

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Author Contributions

D.M.F. and S.R. led the conceptualization of the study, while L.N. and L.A. designed the research methodology. Software management and data processing were handled by M.K.A. Validation of research procedures and results was conducted collaboratively by D.M.F., S.R., and L.N. Formal data analysis was performed by L.A., supported by the investigative efforts of M.K.A. Resource management was coordinated by S.R., and data curation was completed by M.K.A. The initial manuscript draft was prepared by D.M.F. and S.R., with subsequent review and editing carried out by L.N. and L.A. Visualization of the study findings was developed by M.K.A., under the supervision of D.M.F. Project administration was managed by S.R., and funding acquisition was led by D.M.F.

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Conflicts of Interest

The authors declare no conflict of interest.

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