



The Impact of Offering Cassava Leaf and Chicken Liver Dishes on Enhancing Haemoglobin Levels in Pregnant Women During the 2nd and 3rd Trimesters at Maluku Health Center

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Abstract. Anaemia in pregnant women can elevate the risk of health issues for both the mother and the foetus. The incorporation of indigenous foods, such cassava leaves and chicken liver, can enhance the intake of iron, protein, folate, and vitamin B12. This study is to examine alterations in haemoglobin levels following the introduction of cassava leaf and chicken liver diets for pregnant women in their second and third trimesters at the Maluku Health Center. Quantitative pre-experimental research employing a one-group pretest-posttest design utilising simulated data from 29 pregnant women. The intervention consisting of a cassava leaf and chicken liver diet was administered for a duration of 14 days. Haemoglobin levels were assessed pre- and post-intervention with a digital hemoglobinometer. The data were examined via the Paired t-test at a significance threshold of 0.05. The mean haemoglobin level rose from 10.05 ± 0.53 g/dL prior to the intervention to 10.91 ± 0.51 g/dL subsequent to the intervention, reflecting an average rise of 0.86 ± 0.24 g/dL. The Paired t-test results indicated a statistically significant difference in haemoglobin levels pre- and post-intervention ($p < 0.001$). The use of cassava leaf and chicken liver in menus may enhance haemoglobin levels as an adjunct to a balanced diet and blood supplement tablets. Additional study including a control group is necessary to validate these findings.

Keywords: Cassava Leaves; Chicken Liver; Haemoglobin; Pregnant Women; Pregnancy Anaemia.

1. Introduction

Anaemia in pregnant women is a nutritional and health concern characterised by haemoglobin (Hb) levels that are below the usual threshold for the respective gestational age. Anaemia in the second trimester is characterised by haemoglobin levels below 10.5 g/dL, but in the third trimester, it is characterised by haemoglobin levels below 11 g/dL. This condition may arise from heightened iron demands during pregnancy, physiological hemodilution, insufficient nutrient consumption, absorption disorders, infectious diseases, or deficiencies in folic acid and vitamin B12 (World Health Organization [WHO], 2024a; Ministry of Health of the Republic of Indonesia, 2021). Anaemia necessitates particular attention as haemoglobin is essential for the transfer of oxygen to the mother's tissues, placenta, and the growing baby (WHO, 2024a; Ministry of Health of the Republic of Indonesia, 2021).

Anaemia during pregnancy manifests as fatigue, dizziness, pallor, and reduced activity tolerance in the mother, and it may elevate the risk of premature delivery, low birth weight, foetal growth abnormalities, and maternal complications if inadequately managed (WHO, 2024a; Ministry of Health of the Republic of Indonesia, 2021). In Indonesia, anaemia among pregnant women continues to be a significant concern; the 2018 Riskesdas, referenced in the Ministry of Health's publications, documented a prevalence of 48.9% (Ministry of Health of the Republic of Indonesia, 2021). The initiative to distribute Iron Supplement Tablets (IST) has emerged as the primary strategy; however, compliance with IST intake during pregnancy remains suboptimal, necessitating enhancements through dietary modifications and the incorporation of local food sources (Ministry of Health of the Republic of Indonesia, 2024; WHO, 2024b).

The WHO advocates for daily iron and folic acid supplementation during pregnancy as a component of antenatal care to avert maternal anaemia and diminish the likelihood of low birth weight and preterm delivery (WHO, 2024b). Food interventions are essential as a

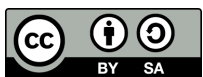
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supplement to iron and folic acid supplementation, as they can fulfil the requirements for protein, iron, folate, vitamins, and minerals through commonly accepted foods for pregnant women (Ministry of Health of the Republic of Indonesia, 2021; WHO, 2024b). Cassava leaves (*Manihot esculenta*) represent a native food with significant potential for utilisation, since they are rich in protein, non-heme iron, vitamin C, provitamin A, and numerous minerals that enhance the nutritional intake for pregnant women (Ahmed et al., 2026; Nurlaeli & Priskusanti, 2025).

Cassava leaves may facilitate haemoglobin synthesis due to their iron and vitamin C content, which enhances the absorption of non-heme iron, particularly when included in a balanced diet (Ahmed et al., 2026; Nurlaeli & Priskusanti, 2025). A study involving second-trimester pregnant women at Puskesmas Rum Balibunga indicated an elevation in average Hb levels following 14 days of cassava leaf consumption; however, the findings warrant cautious interpretation due to the pretest–posttest design lacking a control group (Nurlaeli & Priskusanti, 2025). Cassava leaves contain cyanogenic glycosides; therefore, they must be washed, boiled until fully cooked, and processed using safe methods before to use in a pregnant woman's diet (Padmaja, 1995). In addition to cassava leaves, chicken liver is an animal-derived food rich in protein, heme iron, folate, vitamin B12, and various other micronutrients essential for the synthesis of red blood cells and haemoglobin (Fahmi & Nissa Oper, 2025; U.S. Department of Agriculture Agricultural Research Service, 2024). Heme iron from animal sources is often absorbed more efficiently than non-heme iron from plant sources; thus, the combination of cassava leaves and chicken liver might theoretically yield a meal with a more varied iron source (Fahmi & Nissa Oper, 2025; WHO, 2024a). The consumption of chicken liver by pregnant women must be meticulously regulated regarding portion size and frequency, due to its high retinol or preformed vitamin A content, as excessive intake during pregnancy should be avoided (WHO, 2017; WHO, 2023).

Numerous studies suggest that interventions utilising cassava leaves, chicken liver, or a combination of iron-rich foods may enhance haemoglobin levels; however, the majority employ small sample sizes, lack control groups, or are conducted on populations other than pregnant women in the second and third trimesters (Masluroh, 2022; Nurlaeli & Priskusanti, 2025; Fahmi & Nissa Oper, 2025; Jamhariyah, 2026). Consequently, it is imperative to conduct research on the provision of cassava leaf and chicken liver menus for pregnant women in their second and third trimesters at Puskesmas Maluku, ensuring safe and standardised menus, monitoring of consumption adherence, and documentation of confounding variables such as TTD consumption, additional food intake, infection history, and gestational age (WHO, 2024a; Ministry of Health of the Republic of Indonesia, 2021). This study seeks to examine the impact of incorporating cassava leaf and chicken liver into the diets of pregnant women in their second and third trimesters at Puskesmas Maluku, as a supplementary local food intervention rather than a replacement for iron and folic acid supplements or medical treatment for anaemia.

2. Methods

This study employs a quantitative approach with a one-group pretest-posttest pre-experimental design. The study was carried out at Puskesmas Maluku from January to March 2026. The research population comprises all pregnant women in their second and third trimesters who exhibit anaemia or possess haemoglobin levels below the normative standard. Samples were chosen by purposive or total sampling procedures according to inclusion criteria: pregnant women in their second or third trimester, with haemoglobin levels below 11 g/dL, who consented to participate, and who had no allergies to cassava leaves or chicken liver. Participants with chronic illnesses, haemorrhaging, severe infections, or already undergoing particular anaemia treatment were excluded from the study.

The intervention involved offering a menu of hygienically and safely prepared cassava leaves and chicken liver for pregnant women. Cassava leaves are thoroughly boiled to diminish cyanogenic chemicals, while chicken liver is cooked until completely done. Respondent adherence was assessed by an observation sheet or daily consumption log. Respondents continue to get antenatal care and Iron Supplement Tablets (IST) in accordance with the health center service guidelines.

The independent variable in this study is the supply of a cassava leaf and chicken liver menu, whereas the dependent variable is the haemoglobin level of pregnant women. haemoglobin levels were assessed prior to the intervention (pretest) and subsequent to the intervention (posttest) utilising a calibrated digital haemoglobin meter. The data were examined univariately to delineate the features of the respondents and the average haemoglobin levels. Bivariate analysis was performed utilising the Paired t-test for normally distributed data or the Wilcoxon Signed-Rank test for non-normally distributed data, with a significance threshold of $p < 0.05$. The research was undertaken following the acquisition of

ethical approval, authorisation from Puskesmas Maluku, and informed consent from all participants.

3. Results And Discussion

Respondent Characteristics

Table 1. Characteristics of Pregnant Respondents (n = 29).

Characteristic	Category	n	%
Age	<20 years	2	6.9
	20–35 years	23	79.3
	>35 years	4	13.8
Gestational age	Second trimester	12	41.4
	Third trimester	17	58.6
Education	Primary school	4	13.8
	Junior secondary school	8	27.6
	Senior secondary school	13	44.8
	Higher education	4	13.8
Occupation	Homemaker	22	75.9
	Farmer	4	13.8
	Self-employed	3	10.3
Gravidity	Primigravida	10	34.5
	Multigravida	19	65.5

According to Table 1, the predominant age group of respondents is 20–35 years, comprising 23 pregnant women (79.3%), with the majority in the third trimester, with 17 respondents (58.6%). This demographic often signifies the reproductive age most frequently observed in pregnancy services. The demand for nutrients and iron escalates during pregnancy, particularly in the second and third trimesters, corresponding with foetal development and the rise in maternal blood volume. Consequently, the surveillance of haemoglobin levels, dietary nutrition, and compliance with iron supplement intake must be strengthened by consistent antenatal care services (World Health Organization [WHO], 2024; Ministry of Health of the Republic of Indonesia, 2023).

The majority of respondents possessed a high school education, with 13 individuals (44.8%), and were employed as housewives, totalling 22 individuals (75.9%). Education can enhance a mother's capacity to acquire, comprehend, and implement health knowledge, including details on anaemia, nutritional requirements during pregnancy, the intake of iron-rich foods, and compliance with Iron Supplement Tablets. The role of a housewife may influence the planning of interventions involving cassava leaf and chicken liver menus, as it affects the availability of time for the regular preparation and consumption of nutritious meals; however, this should not be directly construed as a determinant of maternal haemoglobin status (Ningrum et al., 2024; Ministry of Health of the Republic of Indonesia, 2023).

The majority of responders were multigravida, comprising 19 individuals (65.5%), whereas 10 individuals (34.5%) were primigravida. Multiparous mothers may possess prior experience concerning pregnancy examinations, supplement intake, and nutritional requirements. Nonetheless, prior pregnancy experience does not ensure that the requirements for iron, protein, folic acid, and other micronutrients have been adequately fulfilled in the present pregnancy. Consequently, nutrition education and anaemia monitoring must be administered to all pregnant women, irrespective of parity, incorporating local cuisine menus as a supplement to Iron Supplement Tablets (WHO, 2024; Ministry of Health of the Republic of Indonesia, 2020).

Adherence to the Consumption of Cassava Leaf and Chicken Liver Menu as per

Table 2. Adherence of Respondents to the Intervention Menu (n = 29).

Adherence to Menu Consumption During the 14-Day Intervention	n	%
Adherent (consumed the menu for ≥ 12 days)	27	93.1
Non-adherent (consumed the menu for <12 days)	2	6.9
Total	29	100.0

According to Table 2, most respondents shown commendable commitment to the consumption of the cassava leaf and chicken liver meal throughout the intervention period. A total of 27 pregnant women (93.1%) were classified as complying for consuming the

intervention menu for a minimum of 12 out of 14 days, whereas 2 respondents (6.9%) were deemed non-compliant. The elevated compliance suggests that the proposed menu is generally acceptable and practicable for implementation as a local food intervention for pregnant women in the second and third trimesters. Nonetheless, in empirical research, the validation of the menu's approval must be substantiated by data regarding flavour, portion size, simplicity of preparation, and the justifications provided by respondents for not adhering to the scheduled consumption of the menu.

Adherence to consumption is a critical factor in food intervention studies, as variations in haemoglobin levels are affected not only by the nutritional composition of the menu but also by the consistency of intervention consumption. Cassava leaves with chicken liver can enhance the consumption of iron, protein, folate, and other essential elements required for haemoglobin synthesis. This menu should be regarded as an adjunct to a balanced diet and the administration of Iron Supplement Tablets, rather than a replacement for the iron-folic acid supplementation advised in antenatal care (World Health Organization [WHO], 2024; Ministry of Health of the Republic of Indonesia, 2021).

Non-compliant responses must be considered, as non-compliance can diminish intervention exposure and influence the extent of changes in haemoglobin levels. Nausea, alterations in appetite, restricted cooking time, taste preferences, food availability, and familial support can influence compliance; therefore, these should be rigorously documented in the research. Consequently, daily monitoring, education regarding the advantages of the menu, safe processing alternatives, and family engagement should be implemented to sustain adherence to consumption during the intervention.

Variations in Haemoglobin Concentrations Pre- and Post-Intervention

Table 3. Haemoglobin Levels Pre- and Post-Administration of Cassava Leaf and Chicken Liver Menu (n = 29).

Haemoglobin Measurement	Mean $\pm$ SD (g/dL)	Median	Minimum	Maximum
Before the intervention	10.05 $\pm$ 0.53	10.10	9.10	10.90
After the intervention	10.91 $\pm$ 0.51	10.90	9.90	11.90
Increase in haemoglobin level	0.86 $\pm$ 0.24	0.80	0.40	1.30

According to Table 3, the mean haemoglobin concentration of pregnant women before to the introduction of the cassava leaf and chicken liver diet was 10.05 $\pm$ 0.53 g/dL. Following a 14-day intervention, the mean haemoglobin level rose to 10.91 $\pm$ 0.51 g/dL, reflecting an average rise of 0.86 $\pm$ 0.24 g/dL. The results demonstrate an enhancement in haemoglobin levels following the respondents' consumption of the intervention menu. Nevertheless, given this data is fabricated/simulated, the results serve just as an illustration of research findings and should not be construed as empirical evidence. The elevation in haemoglobin levels may be hypothetically associated with the nutritional composition of cassava leaves and chicken liver. Chicken liver provides heme iron, protein, folate, and vitamin B12, essential for red blood cell formation, whereas cassava leaves can enhance the consumption of non-heme iron and additional minerals. The integration of animal and plant-based meals can effectively meet the nutritional requirements of pregnant women within a balanced diet. Haemoglobin is crucial for the transfer of oxygen to the tissues of both the mother and foetus; thus, elevated haemoglobin levels serve as a significant indicator for assessing the risk of anaemia during pregnancy (World Health Organization [WHO], 2024).

Despite the rise in the average haemoglobin level, this alteration cannot be unequivocally attributed solely to the introduction of the cassava leaf and chicken liver menu. Haemoglobin levels may be affected by compliance with Blood Supplement Tablets, daily dietary intake, gestational age, infections, hydration state, and the mother's health condition. Consequently, the cassava leaf and chicken liver dish should be regarded as an adjunct to a nutritious diet and iron-folic acid supplementation in accordance with antenatal care, rather than a replacement for Iron Supplement Tablets or anaemia management by healthcare professionals (WHO, 2024; Ministry of Health of the Republic of Indonesia, 2021).

Normality Assessment of Haemoglobin Level Variance Data

Table 4. Shapiro–Wilk Normality Test Outcomes for Haemoglobin Level Variance.

Variable	p-value	Interpretation
Difference in haemoglobin levels before and after the intervention	0.217	Normally distributed

The Shapiro–Wilk normality test results for the difference in haemoglobin levels pre- and post-intervention, as indicated in Table 4, yielded a p-value of 0.217 ($p > 0.05$). The results reveal that the data about the variance in haemoglobin levels do not exhibit a substantial divergence from a normal distribution. The assumption of normality for parametric analysis has been satisfied, permitting the application of the Paired t-test to

evaluate the difference in haemoglobin levels before and after the administration of the cassava leaf and chicken liver meal (Ghasemi & Zahediasl, 2012; Dahlan, 2022).

Normality testing is a crucial phase in data analysis as it assists researchers in selecting a statistical procedure that aligns with the data's features. In studies using paired measures, such as haemoglobin levels pre- and post-intervention, normalcy should be evaluated based on the difference between the two readings. When the difference data follows a normal distribution, the Paired t-test can be employed to more precisely compare the mean haemoglobin levels. If the data is not normally distributed, the Wilcoxon Signed-Rank Test can be employed for analysis. The normality results in Table 4 do not demonstrate the intervention's efficacy; instead, they merely indicate that the data satisfy one of the statistical prerequisites for parametric analysis. The determination of the effect of cassava leaf and chicken liver menus on haemoglobin levels should rely on the results of the Paired t-test presented in Table 5. Moreover, in empirical study, the analysis of variations in haemoglobin must account for adherence to Blood Supplement Tablet use, daily dietary intake, gestational age, infections, and the health status of pregnant women.

The Impact of Cassava Leaf and Chicken Liver Diet on Haemoglobin Levels

Table 5. Outcomes of the Paired t-test on Haemoglobin Levels Pre- and Post-Intervention (n = 29).

Variable	Mean Difference $\pm$ SD	95% CI	t	df	p-value
Haemoglobin after intervention – haemoglobin before intervention	0.86 $\pm$ 0.24	0.77–0.95	19.28	28	<0.001

The findings of the Paired t-test, as indicated in Table 5, demonstrate a disparity in the mean haemoglobin levels prior to and following the administration of the cassava leaf and chicken liver meal. The mean elevation in haemoglobin levels was 0.86 ± 0.24 g/dL, with a 95% confidence interval of 0.77–0.95 g/dL, a t-value of 19.28, and $p < 0.001$. The results demonstrate a statistically significant elevation in haemoglobin levels following a 14-day intervention in this simulated data. Consequently, the null hypothesis asserting that there is no difference in haemoglobin levels pre- and post-intervention can be dismissed.

Theoretically, elevated haemoglobin levels may correlate with the sufficiency of nutrients that facilitate erythrocyte production. Chicken liver offers heme iron, protein, folate, and vitamin B12, but cassava leaves can enhance non-heme iron absorption and supply additional nutrients. Iron, folate, and vitamin B12 are crucial to haemoglobin production and erythropoiesis; thus, a diet incorporating both animal and plant-based foods may enhance the nutritional intake of pregnant women. The food intervention must be supplemented by a balanced diet and iron-folic acid supplements in accordance with prenatal care guidelines.

Despite the apparent statistical significance, these results cannot conclusively demonstrate that the increase in haemoglobin is solely attributable to the cassava leaf and chicken liver diet. The one-group pretest-posttest design lacks a control group, hence alterations in haemoglobin may also be affected by the intake of Iron Supplement Tablets, dietary consumption, infection status, gestational age, hydration levels, and participant adherence. In current studies, the quantity and frequency of chicken liver ingestion must be assessed cautiously due to its elevated levels of preformed vitamin A. Consequently, the research findings should be regarded as preliminary evidence and validated through studies incorporating control groups, intake tracking, and enhanced control of confounding variables.

4. Conclusion And Recommendation

The simulation study results indicated an elevation in the average haemoglobin levels of pregnant women following a 14-day regimen of cassava leaf and chicken liver consumption. The Paired t-test results indicated a statistically significant difference in haemoglobin levels pre- and post-intervention ($p < 0.001$). The cassava leaf and chicken liver dish may serve as a supplementary nutritional source for pregnant women to aid in the prevention of anaemia.

Community health clinics can educate pregnant women on the intake of nutritious local foods, such as cassava leaves and chicken liver, to complement iron supplementation and a balanced diet. Future research should incorporate a control group, an expanded sample size, an extended intervention period, and regulate variables such as TTD use, daily intake, and Maternal Health Status.

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hoped that the findings of this research would enhance the health of pregnant women and mitigate anaemia.

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