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Potential of Local Plants as Sources of Iron, Folic Acid, and Calcium for Preconception Supplementation

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Abstract

Background: High prevalence of anemia and nutritional deficiencies among Women of Childbearing Age in Indonesia, including Tuban Regency, elevates pregnancy complication risks. Crucial micronutrient supplementation (iron, folic acid, calcium) often overlooks local resources. This study uniquely identifies Tuban's local plants as simultaneous sources of these three vital micronutrients, moving beyond conventional supplements. **Objective**: To identify and analyze the iron, folic acid, and calcium content of local plants in Tuban for preconception supplementation. **Methods**: This descriptive quantitative study analyzed dried powder samples from five local leaf species: katuk, sweet potato, moringa, cassava, and spinach. Iron and calcium were measured by AAS, and folic acid by HPLC, in an accredited laboratory. Data were descriptively analyzed and compared with the WCA Recommended Dietary Allowances (RDA) and the Indonesian Food Composition Table (TKPI) 2017. **Results**: Moringa leaves (*Moringa oleifera*) were an exceptional source of iron (28.04 mg/100g) and calcium (1783 mg/100g), significantly exceeding WCA RDA. Sweet potato leaves (*Ipomoea batatas*) emerged as the best folic acid source (1.59 mg/100g), meeting WCA RDA with a small serving (25g). Spinach and katuk leaves also contributed to iron and folate intake. Micronutrient concentrations in dried powder generally surpassed TKPI 2017 fresh leaf data. **Conclusion**: Local plants, particularly moringa and sweet potato leaves, offer substantial potential as sustainable, economical, and culturally relevant sources of iron, folic acid, and calcium for preconception supplementation, thereby enhancing women's reproductive health in Tuban Regency.

Keywords: Local Plants, Micronutrients, Preconception, Pregnancy Readiness, Sustainable Local Food

Original Research Article

INTRODUCTION

Supplementation nutrients such as iron, folic acid, and other essential micronutrients are recommended for women of childbearing age to support reproductive function, prevent anemia, birth defect, and reduce the risk of pregnancy and birth complications (Dorney & Black, 2018). However, the Indonesian Health Survey in 2023 showed that 27,7% of pregnant women in Indonesia experienced anemia and 16,9% experienced Chronic Energy (Kementerian Kesehatan RI, 2024). In Tuban Regency, the prevalence of anemia among women of childbearing age reached 10,09% and malnutrition 18,07% (Dinkes Provinsi Jatim, 2024). This condition is worrying because anemia and nutritional deficiencies can increase the risk of pregnancy complications and negatively impact maternal health (Keats et al., 2021).

Optimizing health during the preconception period is a crucial foundation for a successful pregnancy and future child health. Interventions during this period can have a significant impact on improving maternal and child health (Stephenson, 2018). Research by Cholila et al (2024) showed that implementing the "Nutristyle" concept during the preconception period had varying effects on nutritional status and anemia prevalence, and women with less knowledge about Nutristyle had 2,093 fold higher risk of experiencing nutritional problems. Previous research has also consistently shown that nutritional status, reduce the risk of anemia, and improve maternal mental health (Firth et al., 2019; Lanyumba et al., 2024; Kamaruddin et al., 2019).

However, scientific literature examining the use of local resources to address nutritional issues during the preconception period in Indonesia is still limited, with the majority of research focusing on commercial supplements. In many areas, communities still rely on traditional knowledge and local natural resources (Elfrida et al., 2021). An initial survey in Tuban Regency identified several plants with potential sources of iron, folic acid, and calcium. However, the specific use of these local plants as essential nutrients for preconception supplementation in Tuban Regency still requires further in depth scientific exploration and validation.

This research is crucial and relevant given the serious challenges in Tuban Regency related to high prevalence of anemia and other nutritional problems among women of childbearing age. This condition has the potential to harm maternal and child health, as well as the sustainability of human resource development. By scientifically leveraging local resources, this research has the potential to provide affordable, sustainable, and culturally relevant solutions to improve women's reproductive health and prevent anemia in pregnant women. This approach not only optimizes natural resources but also empowers communities through local wisdom.

The importance of iron, folic acid, and calcium intake during the preconception period has been recognized and supported by numerous studies. Iron is vital for preventing anemia, which can lead to preterm labor, low birth weight, and an increased risk of maternal and neonatal mortality. Folic acid is crucial for preventing neural tube defects (NTDs) in the fetus, so its supplementation is recommended for all women of childbearing age (Dorney & Black, 2018). Calcium plays a significant role in maintaining maternal bone health and is effective in preventing preeclampsia (Keats et al., 2021).

In line with the importance of these nutrients, various studies have been conducted to investigate the nutritional content of local plants. Fadillah et al (2024) explored the iron content in cassava leaves (*Manihot esculenta crantz*). Čeryová et al (2025) examined the nutritional composition, including essential minerals, of Swiss chard (Beta vulgaris L. subsp. Cicla). Shabita et al (2025) explored and qualitatively tested the active compounds in Polyalthia longifolia leaves. Pratiwi, Novita, et al (2021) compared the iron content in *Moringa oleifera* leaves grown in the highlands and lowlands. Kholifah et al (2015) investigated the iron (Fe) content in water spinach (Ipomoea aquatica forsk). Windayani et al (2025) analyzed the bioactive compounds and antioxidant activity of bekul fruit extract (Ziziphus jujuba mill). While these studies highlight the potential of various local plants as sources of specific nutrients, no comprehensive study has focused on identifying a combination of local plants in Tuban regency as a simultaneous source of all three essential micronutrients (iron, folic acid, and calcium) for preconception supplementation. This gap underscores the need for focused, localized research to leverage local wisdom and biodiversity to address nutritional issues.

The primary objective of this study was to identify local plants in Tuban Regency containing iron, folic acid, and calcium for preconception supplementation to support pregnancy readiness.

Specifically, this study aimed to determine the iron, folic acid, and calcium content profiles of identified local plants based on laboratory analysis.

State of the art current research in preconception nutrition largely focuses on conventional vitamin and mineral supplements (Dorney & Black, 2018). While effective, these supplements may not always be accessible or affordable for all conventional approaches by focusing on the sustainable and culturally appropriate use of local biodiversity.

The novelty of this study lies in its specific geographic focus (Tuban Regency) and its comprehensive approach to simultaneously identify local plant source of three essential micronutrients (iron, folic acid, and calcium) explicitly for preconception supplementation. Unlike previous studies that may analyze individual nutrients within a range of plants (Fadillah et al., 2024; Kholifah et al., 2015b; Pratiwi et al., 2021), this study aims to provide a holistic identification of multi-nutrient-rich local plants tailored to be an innovative, affordable, and locally relevant solution to improve maternal and child health. The study's finding are expected to significantly contribute to the development of new preconception supplementation strategies based on indigenous plant knowledge and local resources, thereby enhancing scientific understanding of ethnobotanical applications in reproductive health.

MATERIALS AND METHODS

This study used a descriptive quantitative approach, specifically focusing on laboratory analysis to determine the iron, folic acid, and calcium content profiles of various local plants identified in Tuban Regency. The descriptive design was chosen because the primary objective of the study was to present an accurate picture of the nutritional characteristics of the plant samples studied, without testing hypotheses or causal relationships between variables. The research flow is systematically divided into four main stages: sampling, sample preparation, laboratory analysis, and data analysis.

The sample size consisted of 3-5 local plant species. Species selection was based on inclusion criteria from an initial survey at traditional market in Tuban Regency and discussions with community leaders. The primary focus was on plants commonly consumed or believed to beneficial as sources of iron, folic acid, and calcium. The plant parts selected were those most commonly consumed by the community, in this case the leaves.

The research procedure includes three main stages:

1) Sampling, plant samples were taken directly from representative locations in Tuban Regency. The leaves were chosen because they are the part commonly consumed by local people.
2) Sample Preparation, this stage was crucial to minimize nutrient degradation or contamination. Samples are sorted and thoroughly washed with running water to remove dirt, dust, or pesticides (Čeryová et al., 2025; Fadillah et al., 2024). After being drained and cut into small pieces (if necessary), the samples are dried in an oven at 40-60°C to reduce water content without damaging heat sensitive nutrients (Fadillah et al., 2024; Shabita et al., 2025). The drying process continued until a constant weight was achieved, yielding approximately 100-150 grams of dry powder from 500-1000 grams of fresh samples, depending on the plant species. The dried samples are then ground using a blender to form a homogeneous powder and stored in a sterile, airtight container to maintain nutrient stability.
3) Laboratory Analysis, the analysis is performed in an accredited laboratory to ensure the accuracy and reliability of the results:
    a. Iron (Fe) content, measured using Atomic Absorption Spectrophotometry (AAS), a sensitive and precise method for metal analysis in biological matrices (Kholifah et al., 2015a; Pratiwi et al., 2021).
    b. Folic acid content, measured using High Performance Liquid Chromatography (HPLC), a standard method for the analysis of vitamin complexes with high accuracy (Windayani et al., 2025)
    c. Calcium (Ca) content, measured using Atomic Absorption Spectrophotometry (AAS), which is effective and accurate for calcium analysis in plant samples (Čeryová et al., 2025).

Quantitative data from laboratory analysis will be comprehensively tabulated. These results will be compared with the Indonesian Food Composition Table and the national nutritional adequacy intake, specifically for women of childbearing age. Data interpretation will focus on identifying plant species with the highest and most significant iron, folic acid, and calcium content, which have the potential to be developed as sources of preconception supplementation.

This research has obtained ethical approval from the Research Ethics Board of the Nahdlatul Ulama Tuban Institute of Health Sciences with certificate number: 104/ 0084223523/ LEPK.IIKNU/ VI/ 2025.

RESULTS

The results of laboratory analysis of five types of local plants commonly found in Tuban Regency, namely katuk leaves (*Sauropus androgynus*), sweet potato leaves (*Ipomoea batatas*), moringa leaves (*Moringa oleifera*), cassava leaves (*Manihot esculenta*), and spinach leaves (*Amaranthus spp*.) are presented in Table 1. These data include proximate analysis of macronutrients as the content of essential micronutrients (iron, folic acid, and calcium) per 100 gram of dry powder sample.

Table 1. Results of Proximate and Micronutrient Analysis of Local Plant Leaves in Tuban Regency (per 100 gram dry powder)

Parameter	***Sauropus androgynus***	***Ipomoea batatas***	***Moringa oleifera***	***Manihot esculenta***	***Amaranthus spp.***
Carbohydrates (%)	66,5	66,42	50,96	84,81	84,81
Protein (%)	11,59	12,89	26,17	3,84	3,32
Fat (%)	1,17	1,06	6,83	0,41	0,37
Water (%)	6,56	5,98	4,95	5,05	6,55
Ash (%)	14,03	15,65	11,09	5,89	4,95
Calcium (%)	0,268	0,377	1,783	0,056	0,083
Iron (mg/100 g)	3,12	5,42	28,04	3,68	5,39
Folate (mg/100 g)	0,48	1,59	0,26	0,12	0,59

The average value of the duplicate test

Overall, the diverse nutritional profiles demonstrate the significant potential of the these plants as sources of nutrition, particularly essential micronutrients to support pregnancy readiness in women of childbearing age and throughout pregnancy. These results underscore the superiority of Moringa leaves in iron and calcium content, and sweet potato leaves (*Ipomoea batatas*) as an excellent source of folic acid. Spinach, katuk leaves (*Sauropus androgynus*) and cassava leaves also provide significant nutritional contributions, albeit in varying amounts. Further comparisons with the Recommended Dietary Allowances for women of childbearing age are presented in Table 2 to provide a clearer picture of the potential for meeting daily nutritional needs.

Table 2. Summary of Comparison of Micronutrient Nutritional Content in Local Plants with Recommended Dietary Allowances (RDA) in Women of Childbearing

Micronutrients	RDA for Women of Childbearing (mg/day)	RDA for Pregnant Women (mg/day)	Leaves	Content (mg/100 g dry powder)	Description
Iron	**18**	**27**	*Moringa oleifera*	28.04	**Very high,** 65 g has met the RDA for women of childbearing
			Ipomoea batatas	5.42	**Currently**, requies large portions (330 g for women of

					childbearing) to meet the RDA
			Amaranthus spp.	5.39	**Currently**, requies large portions such as *Ipomoea batatas*
			Manihot esculenta	3.68	**Low**, remains valuable in diversifying the diet
			Sauropus androgynus	3.12	**Low**, low to moderate contribution
Folate	**0,4 (400 mcg)**	**0,6 (600 mcg)**	*Ipomoea batatas*	1.59	**Very high**, a small portion (25 g for women of childbearing, 38 g for pregnant women) already meets the RDA. Great potential for preventing birth defects
			Amaranthus spp.	0.59	**High**, medium portion (68 g for women of childbearing) meets the RDA
			Sauropus androgynus	0.48	**High enough**, a medium portion (83 g for women of childbearing) already meets the RDA
			Moringa oleifera	0.26	**Currently**, requires larger portion (154 g for women of childbearing)
			Manihot esculenta	0.12	**Low**
Calcium	**1000**	**1200**	*Moringa oleifera*	1783	**Very high**, 100 g exceeds the RDA for women of childbearing and pregnant women
			Ipomoea batatas	377	**Currently**, requies large portions (265 g for women of childbearing)
			Sauropus androgynus	268	**Currently**, requies large portions (373 g for women of childbearing)
			Amaranthus spp.	83	**Low**, requires a very large portion
			Manihot esculenta	56	**Very low**

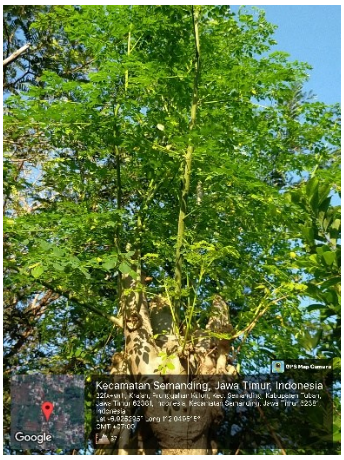
To provide a deeper context regarding the potential of local plants in processed from (dry powder), Table 3 present a comparison of the essential micronutrient content (iron, folic acid, and calcium) obtained from the laboratory analysis of this study with the average data from the 2017 Indonesian Food Composition Table for this plants in fresh form.

Table 3. Summary of Comparison of Micronutrient Nutritional Content in Local Plants with Recommended Dietary Allowances (RDA) in Women of Childbearing

Micronutrients	Leaves	Content (mg/100 g dry powder)	Indonesian Food Composition Table (mg/100 g fresh material)	Description
Iron	*Moringa oleifera*	28.04	7.0	**Higher** in dry powder
	Ipomoea batatas	5.42	0.7	**Higher** in dry powder
	Amaranthus spp.	5.39	3.9	**Higher** in dry powder
	Manihot esculenta	3.68	2.7	**Higher** in dry powder

	Sauropus androgynus	3.12	2.7	**Higher** in dry powder
Folate	*Ipomoea batatas*	1.59	0.126	**Much Higher** in dry powder
	Amaranthus spp.	0.59	0.108	**Much Higher** in dry powder
	Sauropus androgynus	0.48	0.080	**Much Higher** in dry powder
	Moringa oleifera	0.26	There is no specific data	-
	Manihot esculenta	0.12	0.022	**Higher** in dry powder
Calcium	*Moringa oleifera*	1783	440	**Much Higher** in dry powder
	Ipomoea batatas	377	42	**Much Higher** in dry powder
	Sauropus androgynus	268	204	**Higher** in dry powder
	Amaranthus spp.	83	267	**Lower** in dry powder
	Manihot esculenta	56	165	**Lower** in dry powder

Notes: The 2017 Indonesian Food Composition Table, data for folate is typically presented in mcg. for comparison, 1 mg = 1000 mcg. Differences in content can be caused by plant genetic variation, growing conditions, and especially by the method of measuring dry powder versus fresh material in the Indonesian Food Composition Table. Conversion to dry powder generally increases nutrient concentration due to water loss.



Moringa leaves (*Moringa oleifera*)

katuk leaves (*Sauropus androgynus*)


spinach leaves (*Amaranthus spp.*)

sweet potato leaves (*Ipomoea batatas*)

cassava leaves (*Manihot esculenta*)

Figure 1. Local Plants in Tuban Regency

DISCUSSION

Laboratory analysis of five local plants in Tuban Regency (katuk leaves, sweet potato leaves, moringa leaves, cassava leaves, and spinach leaves) presents a diverse and promising nutritional profile, particularly as a source of essential micronutrients for pregnancy readiness in women of childbearing age and pregnant women. The main focus of this study is on the content of iron, folic acid, and calcium, which are crucial during the preconception period. To provide boarder context, these results are compared with data available in the 2017 Indonesian Food Composition Table, as well as the Recommended Nutritional Adequacy Intake (Kementerian Kesehatan RI, 2018).

Iron deficiency anemia is a serious public health problem, particularly among women of childbearing age and pregnant women, with significant impacts on maternal and fetal health (Clarke-Deelder et al., 2025; Obianeli et al., 2024). The results of this study significantly highlight *Moringa oleifera* leaves as an exceptional source of iron, with a content of up to 28.04 mg per 100 grams of dry powder. This figure substantially exceeds the recommended daily intake of iron for women of childbearing age (18 mg/day) and pregnant women (27 mg/day). As shown in Table 3, a comparison with the 2017 Indonesian Food Composition Table indicates that 100 grams of fresh moringa leaves contain an average of 7 mg of iron. Conversion to dry powder (assuming water loss of approximately 75-80%) will significantly increase the nutrient concentration, and the results of this study are consistent with this increase, even indicating a potential higher than average estimate. This strongly confirms the potential of moringa leaves as s highly effective dietary intervention for the prevention and treatment of anemia (Benkhnigue et al., 2022; Lanyumba et al., 2024; Lukmanul Hakim et al., 2024; Usman et al., 2025). Numerous ethnobotanical studies have also confirmed the traditional use of moringa leaves to treat anemia in various communities worldwide (Ameade et al., 2024; Ngunde-Te-Ngunde et al., 2022). These nutritional benefits of moringa leaves are consistent with research showing that this plants is a nutritional powerhouse with diverse pharmacological and functional applications (Arshad et al., 2025; Gopalakrishnan et al., 2016; Panova et al., 2025; Pareek et al., 2023). The drying process has slso been shown to increase the nutrient desensity of moringa, making moringa leaf powder an efficient choice (Afriza et al., 2025; Irwan, 2020).

Although sweet potato leaves (5.42 mg/100 g dry powder), and katuk leaves (5.39 mg/100 g dry powder), cassava leaves (3.68 mg/100 g dry powder), and katuk leaves (3.12 mg/100 g dry powder) have lower iron content then moringa, their contribution cannot be ignored. Reffering to Table 3, the 2017 Indonesian Food Composition Table noted that 100 grams of fresh sweet potato leaves contain approximately 0.7 mg of iron, spinach leaves 3.9 mg, cassava leaves 2.7 mg and katuk leaves 2.7 mg. after conversion to dry powder, the results of this study showed higher iron concentrations for all four iron, although larger portions are required to meet the RDA for a single plants. In the context of diverse dietary patterns, sweet potato leaves and spinach still provide significant nutritional intake (Rahayu et al., 2024; Tharmabalan, 2023). The bioavailability of iron prom plant source can vary, and interactions with other dietary factors, such as vitamin C intake, can enhance its absorption (Ancuceanu et al., 2015; Feumba Dibanda et al., 2024; Murgia & Morandini, 2024). Previous studies have also demonstrated the potential of sweet potato leaves in increasing hemoglobin levels in pregnant women (Kuswati & Suwanti, 2015; Sari & Wigati, 2021) and the contribution of katuk leaves in preventing anemia (Majid & Muchtaridi, 2018; Surya Atmaja et al., 2022), strengthening these findings.

Folic acid is an essential micronutrient that is essential before and during pregnancy to prevent neural tube defects (NTDs) in the fetus, a serious neurological condition that can be avoided with adequate folate intake (De-Regil et al., 2016; Dorney & Black, 2018). The findings of this study reveal sweet potato leaves (Ippomoea batatas) as a highly efficient source of folic acid, with a content 1.59 mg per 100 grams of dry powder. The daily RDA for folate for women of childbearing is 0.4 mg (400mcg), and for pregnant women it is 0,6 mg (600 mcg). By consuming only about 25 grams of sweet potato leaf powder, the daily RDA for folate for women of childbearing can be met, and about 38 grams for pregnant women. Based on Table 3, the 2017 Indonesian Food Composition Table recorded folate in fresh sweet potato leaves at approximately 0.126 mg (126 mcg) per 100 g. The concentration of 1.59

mg/100 g of dry powder from this study showed a substantial increase (>12 fold) due to the drying process, confirming the significant potential of sweet potato leaves in NTD prevention. This potential makes sweet potato leaves a strong candidate for preconception nutrition interventions, in line with global recommendations for micronutrient supplementation in women of reproductive age (Bhutta et al., 2013; Lassi et al., 2014; Nguyen et al., 2021). The effect of processing on folate can vary (Czarnowska-Kujawska et al., 2022), but the drying method in this study showed beneficial results.

Spinach leaves (0.59 mg/100 g dry powder) and katuk leaves (0.48 mg/100 g dry powder) are also good sources of folate. Table 3 shows that fresh spinach contains approximately 0.108 mg (108 mcg) of folate and fresh katuk leaves 0.080 mg (80 mcg) of folate per 100 g (Kementerian Kesehatan RI, 2018). The results of this study, after conversion to dry powder, again showed significantly higher concentrations (more than 6-8 times). To meet the RDA for women of childbearing, approximately 68 grams of spinach leaf powder or 83 grams of katuk leaf powder are needed. Traditionally, katuk leaves are widely known to support maternal health, especially in increasing breast milk production in breastfeeding mothers and their contribution to increasing hemoglobin levels in pregnant women with anemia has been explored (Rosa et al., 2022; Surya Atmaja et al., 2022). Although moringa leaves (0.26 mg/100 g dry powder) and cassava leaves (0.12 mg/100 g dry powder) provide relatively lower folate contributions, they still contribute to total folate intake in a balanced diet. The importance of adequate folic acid intake is continually emphasized in the context of preconception nutrition interventions and optimizing pregnancy outcome (Stephenson, 2018; Wantong et al., 2024). Moringa compounds have been analyzed for their potential interactions with folate receptors, suggesting relevance at the molecular level (Hasan & Resvita Bahi, 2025).

Calcium is an essential mineral vital for healthy bones and teeth, nerve function, muscle contraction, and is also crucial in preventing pregnancy complications such as preeclampsia (Keats et al., 2021). The recommended daily intake of calcium for women of childbearing age is 1.000 mg. day, and increases to 1.200 mg/day for pregnant women (Kementerian Kesehatan RI, 2019). In this study, the analysis of moringa leaves showed a very high calcium content, reaching 1.783 mg per 100 grams of dry powder. Reffering to table 3, the 2017 Indonesian Food Composition Table recorded calcium in fresh moringa leaves at approximately 440 mg per 100 g. The concentration of 1.783 mg/100 g dry powder in this study represents a more than fourfold increase compared to the fresh form due to the removal of water. These findings indicate that consuming 100 grams of moringa leaf powder is more than sufficient to meet or even exceed the daily calcium needs of women of childbearing age and pregnant women. These result are supported by various studies that consistently show high mineral content in moringa leaves, including other essential macro and microminerals, which makes it a natural "superfood" (El Bilali et al., 2024; Manggara & Shofi, 2018; Panova et al., 2025).

Sweet potato leaves contain 377 mg of calcium per 100 g of dry powder. Tabel 3 shows that the 2017 Indonesian Food Composition Table recorded fresh sweet potato leaves containing 42 mg of calcium per 100 g, meaning the concentration in the dry powder is more than ninefold higher. *Sauropus androgynus* leaves contain 268 mg per 100 g of dry powder (the 2017 Indonesian Food Composition Table: 204 mg/100 g fresh), indicating a fairly good and slightly increasing concentration. Although sweet potato leaves and *Sauropus androgynus* leaves require larger portions to meet the RDA for women of childbearing, their contribution remains significant. The calcium contributions from spinach leaves (83 mg/100 g dry powder; the 2017 Indonesian Food Composition Table : 267 mg/100 g fresh) and cassava leaves (56 mg/100 g dry powder; the 2017 Indonesian Food Composition Table : 165 mg/100 g fresh) are relatively lower than those from moringa, and Table 3 clearly shows that the calcium content of the dry powders in spinach and cassava appears lower than that of the fresh Indonesian Food Composition Table. This decrease may indicate plant genetic variation, growing conditions, or differences in processing methods that affect the final content, as well as the measurement method for the dry powder versus the fresh material in the Indonesian Food Composition Table. Therefore, spinach and cassava leaves cannot be relied upon as the sole source of calcium to meet the RDA, but they still contribute to total calcium intake in an varied diet (Fathir et al., 2021; Husain et al., 2020). Given the high prevalence of micronutrient deficiencies in developing countries (Black et al., 2013), the use of local plants (especially *Moringa*) which are rich in calcium can be an effective strategy to improve nutritional status (Aini et al., 2023; Rahayu et al., 2024).

Overall, this study strongly confirms the great potential of local plants, particularly moringa and sweet potato leaves, as a sustainable and nutrient rich solution to address deficiencies of essential micronutrient such as iron, folic acid, and calcium in women of childbearing age. As illustrated in Table 3, a comparison with the 2017 Indonesian Food Composition Table shows that the dried powdered forms of these plants offer significantly higher nutrient concentrations than their fresh forms, making them an efficient option for supplementation. Nutritional interventions preconceptionally and during pregnancy are crucial for the “First 1000 Days of Life” and provide long term benefits to maternal and child health (Amini, P., Asif, H., & Jeyaseelan, 2020; Baird et al., 2017; Guiomar De Almeida Brasiel & Potente Dutra Luquetti, 2021; Stephenson, 2018).

The use of these plants can be integrated into community nutrition programs though various means, such as food diversification, local food fortification, or the development of leaf based processed products (Hestiyana et al., 2024). Nutrition education on how to optimally process and consume these leaves is also essential to maximize micronutrient bioavailability. Further research is highly recommended to explore the bioavailability of micronutrient from various leaf preparations (e.g., fresh, boiled, powder, or extracted) to better understand how effectively these nutrients are absorbed by the body. This aspect was not explored in depth in this study.

A limitation of this study is the limited focus of the analysis on five local plant species in Tuban Regency, so there may be other plants eith similar potential than have not yet been identified. Furthermore, this study is quantitative descriptive and does not include qualitative aspects such as community acceptance, consumption patterns, or socio-cultural factors influencing the use of these plants in the community. Community based intervention studies involving the routine consumption of these plants are needed to evaluate their clinical impact on nutritional status and pregnancy outcomes in women of childbearing and pregnant women. Qualitative aspects of community acceptance, preferences, and processing practices are also important to assess to develop optimal and sustainable utilization strategies. Assessment of the safety of long term consumption and potential interactions with other drugs also require consideration in future research, given the bioactive compounds contained in some plants.

CONCLUSION

This study successfully identified five types of local plants in Tuban regency, namely katuk leaves (*Sauropus androgynus*), sweet potato leaves (*Ipomoea batatas*), moringa leaves (*Moringa oleifera*), cassava leaves (*Manihot esculenta*), and spinach leaves (*Amaranthus spp*.), which showed significant potential as sources of iron, folic acid, and calcium for preconception supplementation to support pregnancy readiness. The nutritional profiles of these plants varied; moringa leaves stood out as a very high source of iron (28.04 mg/100 g) and calcium (1783 mg/100 g), even exceeding the recommended daily intake (RDA) for women of childbearing age and pregnant women. Meanwhile, sweet potato leaves were identified as the best source of folic acid (1.59 mg/100 g) among the samples tested, which is very significant for the prevention of neural tube defects. Spinach leaves and katuk leaves also made important contributions in meeting iron and folic acid needs. Although cassava leaves exhibit relatively lower micronutrient content, this crop still has value as part of a diversified diet. These findings confirm that utilizing local plants in dry powder can be a sustainable, economical, and culturally relevant solution to address micronutrient deficiencies and improve reproductive health in Tuban Regency.

For future research, it is recommended to explore the bioavailability of micronutrients from various processed forms of the plants (e.g., fresh, boiled, dried into powder, or extracted) to better understand how effectively these nutrients are absorbed by the body. Furthermore, community based intervention studies involving the routine consumption of these plants are need to evaluate their clinical impact on nutritional status and pregnancy outcome in women of childbearing and pregnant women. Qualitative aspects regarding community acceptance, preferences, and processing practices are also important to examine to develop optimal and sustainable utilization strategies.

CONFLICT OF INTEREST

There is no conflict of interest in this research

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