MICRO NUTRIENT COMPOSITION OF *EMILIA PRAETERMISSA* LEAF

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CHAPTER ONE

INTRODUCTION AND LITERATURE REVIEW

1.1 Introduction and Background Study

Micronutrients vitamins and trace minerals are indispensable for human health, supporting growth, metabolic functions, immune responses, and overall wellbeing (World Health Organization, 2020). Deficiencies in micronutrients such as iron, zinc, calcium and vitamin A remain major global public-health challenges, especially in low- and middle-income countries where dietary diversity is limited (Bailey *et al.,* 2015). In this context, identifying and promoting under-utilised indigenous leafy plants that are nutrient-dense is increasingly seen as a viable strategy for improving nutrition, food security and health outcomes (Osafo, 2021; Turner *et al.,* 2021).

Emilia praetermissa Milne-Redh., a herbaceous plant in the family Asteraceae found in West and Central Africa, grows readily in roadside and open-field conditions and is used in traditional medicine for ailments such as inflammation, cough, wounds or hypertension (Ebhohon *et al.,* 2022). Although it is occasionally consumed as a leafy vegetable in some communities, the nutritional composition—particularly its micronutrient profile—has been sparsely documented in scientific literature. Meanwhile, studies on other under-utilised leafy vegetables in Africa have shown remarkably high levels of minerals (for example Ca or Fe) and vitamins compared with staple crops (Turner *et al.,* 2021; Umerah and Nnam, 2019).

Despite this promise, indigenous leafy vegetables (ILVs) including *E. praetermissa* remain under-utilised, in part because of limited nutritional data, low consumer awareness, and weak value-chains (Osafo, 2021; Chacha, 2024). Understanding the micronutrient composition of *E. praetermissa* therefore has multiple benefits: it can provide scientific evidence for its nutritional potential, support its use in dietary diversification efforts and possibly link its traditional use and bioactive properties to micronutrient-driven physiological effects.

Accordingly, this study aims to determine the micronutrient composition of *Emilia praetermissa*, focusing on essential vitamins and minerals. The findings are expected to contribute to the body of knowledge around under-utilised leafy vegetables in Nigeria, support food-based strategies to combat micronutrient deficiency, and open avenues for leveraging indigenous plant resources in nutrition and health.

Figure 1 Emilia praetermissa

Source: Wikipedia

1.2 AIMS AND OBJECTIVES

Aim of the Study

This study aims to determine the micronutrient composition of *Emilia praetermissa*, focusing on the identification and quantification of essential vitamins and minerals. It seeks to provide scientific data on the plant's nutritional potential, establish its relevance as a source of vital micronutrients, and contribute to efforts aimed at promoting indigenous vegetables for improved nutrition and food security.

Objectives

To achieve the overall aim of this research, several specific objectives were established to guide the study process and ensure comprehensive evaluation of the plant's nutritional profile. These objectives are to:

- Determine the concentration of essential minerals such as iron, zinc, calcium, magnesium, and potassium in *Emilia praetermissa*.
- Quantify the levels of key vitamins, including vitamins A, C, and E, present in the plant.
- Evaluate the overall micronutrient profile to assess the nutritional potential of *Emilia praetermissa*.
- Compare the micronutrient composition of *Emilia praetermissa* with values reported for other commonly consumed leafy vegetables.
- Provide baseline scientific data that can support the utilization of *Emilia praetermissa* in nutrition, food formulation, and public health improvement.

1.3 Statement of the Problem

Micronutrient deficiencies remain a major public-health challenge, especially in developing countries where diets are dominated by energy-dense but nutrient-poor staples. This condition, often referred to as "hidden hunger," leads to serious health problems such as anemia, impaired immunity, stunted growth, and reduced cognitive performance (Bailey *et al.,* 2015; Osafo, 2021). To tackle this global concern, there is a growing need to identify accessible and affordable natural sources of micronutrients from local food systems (Umerah and Nnam, 2019).

Although indigenous leafy vegetables are known to possess high nutritional and medicinal value, many remain underutilized and insufficiently studied (Turner *et al.,* 2021; Chacha, 2024). *Emilia praetermissa* Milne-Redh., a common herb in tropical Africa, is traditionally used for treating wounds, inflammation, and hypertension (Ebhohon *et al.,* 2022). Despite its availability and ethnomedicinal uses, limited information exists on its micronutrient composition, hindering its recognition as a potentially valuable source of dietary vitamins and minerals.

Comprehensive evaluation of the micronutrient profile of *Emilia praetermissa* is therefore essential to establish its nutritional significance. Generating such data will provide scientific evidence to promote its inclusion in food-based strategies for combating micronutrient deficiencies, improving dietary diversity, and enhancing food and nutrition security in Nigeria and other developing regions (Osafo, 2021; Chacha, 2024).

1.4 Significance of the Study

This study is significant because it provides vital scientific information on the micronutrient composition of *Emilia praetermissa*, an indigenous leafy plant that has received little research attention. The findings will contribute to the growing body of knowledge on underutilized vegetables and their potential to address micronutrient deficiencies, which remain a global public health concern (Bailey *et al.,*2015).

By establishing the levels of essential vitamins and minerals present in *E. praetermissa*, this study will promote its recognition as a valuable dietary source capable of improving nutritional diversity in both rural and urban populations. Such information is essential for encouraging the consumption of nutrient-rich local vegetables as part of sustainable food-based approaches to combating malnutrition (Umerah and Nnam, 2019; Turner *et al.,* 2021).

Furthermore, the research will provide baseline data for future studies on the functional and nutraceutical potentials of *E. praetermissa*. This could support the development of local food products, enhance public health nutrition programs, and inform policy decisions on the promotion of indigenous crops (Osafo, 2021; Chacha, 2024). Ultimately, the study aligns with global efforts to achieve Sustainable Development Goal 2, which emphasizes ending hunger and promoting sustainable agriculture through improved nutrition.

1.5 Justification of the Study

Micronutrient deficiencies, commonly known as “hidden hunger,” continue to threaten public health in many developing countries, leading to malnutrition, anemia, weakened immunity, and reduced productivity (Bailey, West, and Black, 2015). Despite increased awareness, access to balanced diets rich in essential vitamins and minerals remains limited, particularly among low-income populations (Osafo, 2021). Therefore, exploring affordable, accessible, and nutrient-rich indigenous plants offers a sustainable strategy for addressing these nutritional gaps.

Emilia praetermissa is a widely available herb in tropical Africa that is often overlooked despite its local use as both a food and medicinal plant (Ebhohon *et al.,* 2022). Preliminary studies on related Emilia species have revealed the presence of bioactive compounds and minerals, suggesting significant nutritional potential (Umerah and Nnam, 2019). However, scientific information on the micronutrient composition of *E. praetermissa* remains scarce. Generating such data is essential for validating its nutritional value and promoting its inclusion in diets, nutrition programs, and small-scale food industries.

Justifying this study, therefore, lies in its potential to bridge the knowledge gap on the nutritional profile of *E. praetermissa*. The results could serve as baseline data for researchers, nutritionists, and policymakers to promote indigenous vegetables in achieving food security, improving public health, and supporting sustainable agriculture (Turner *et al.,* 2021; Chacha, 2024). This aligns with global nutrition goals and the Sustainable Development Goals (SDGs) aimed at eradicating hunger and malnutrition through the utilization of local biodiversity.

1.6 LITERATURE REVIEW OF *EMILIA PLAETERMISSA*

1.6 Origin of *Emilia Plaetermissa*

Emilia praetermissa Milne-Redh. belongs to the family Asteraceae, one of the largest families of flowering plants. The genus Emilia consists of about 50–100 species distributed mainly in tropical and subtropical regions of Africa and Asia. *E. praetermissa* is believed to be native to tropical Africa, where it occurs naturally in open fields, roadsides, and cultivated farmlands (CABI, 2024).

According to the Tropical Plants Database (2023) and Global Biodiversity Information Facility (GBIF, 2024), the species is indigenous to West and Central Africa, with records from Nigeria, Ghana, Cameroon, Uganda, and the Democratic Republic of Congo. It thrives in warm, humid climates and often behaves as a pioneer species in disturbed soils, which supports its rapid spread across tropical regions.

Although *Emilia praetermissa* is most common in Africa, it has been introduced and naturalized in several tropical and subtropical areas worldwide through human activity and seed dispersal. Its adaptability to different soil types and ecological zones has contributed to its wide occurrence and survival as both a wild edible plant and medicinal herb (Okunlola *et al.,* 2022; CABI, 2024).

1.6.2 Geographical and Evolutionary Origin

The genus Emilia is believed to have originated in tropical Africa, with several species later spreading to Asia and other tropical regions (Tropical Plants Database, 2023). Among them, *Emilia praetermissa* is indigenous to tropical Africa, particularly in West and Central Africa, where it thrives in open fields, roadsides, fallow lands, and disturbed soils. The species has been recorded in Nigeria, Ghana, Cameroon, Uganda, the Democratic Republic of Congo, Sudan, and Tanzania, confirming its African origin and ecological versatility (GBIF, 2024).

The evolutionary success of *E. praetermissa* is attributed to its adaptive traits, including a short life cycle, efficient seed dispersal through wind (anemochory), and tolerance to various soil and climatic conditions. These characteristics allow the plant to colonize new areas rapidly, especially in regions undergoing agricultural or urban disturbance (Okunlola *et al.,* 2022).

1.6.3 Ecological Adaptation

Emilia praetermissa grows best in tropical lowlands with mean annual temperatures between 25–32 °C and annual rainfall ranging from 800–2000 mm. It prefers well-drained loamy or sandy soils, but can also survive in nutrient-poor or slightly acidic environments. Its high regeneration ability and wide ecological amplitude make it a pioneer species, contributing to early vegetation recovery after land disturbance (Tropical Plants Database, 2023).

Because of its resilience and spontaneous growth habit, *Emilia praetermissa* plays a subtle ecological role in soil nutrient cycling and biodiversity conservation, especially in fallow farmlands and rural ecosystems. Its presence is often an indicator of fertile, moist soil suitable for agricultural cultivation (Okunlola *et al.,* 2022).

1.7 Botanical Description of *Emilia praetermissa*

Emilia praetermissa Milne-Redh. is a herbaceous annual plant belonging to the family Asteraceae (Compositae), one of the largest and most diverse families of flowering plants. The species is characterized by its delicate habit, bright inflorescences, and adaptability to disturbed soils in tropical regions (CABI, 2024).

1.7.1 Morphological Characteristics

1.17.1. Habit

Emilia praetermissa is an erect, slender, and softly pubescent annual herb, typically growing between 30 – 100 cm in height. The plant may appear slightly branched or unbranched depending on the growth environment. The stem is cylindrical, green to purplish, and covered with fine hairs that give it a soft texture (Okunlola *et al.,* 2022).

1.17.2. Leaves

The leaves are alternate and simple, with variations in shape along the stem. The lower leaves are oblanceolate to lyrate, measuring about 5–15 cm long, with petioles that are winged or slightly clasping the stem. The upper leaves are smaller, sessile, and lanceolate, gradually reducing in size toward the inflorescence. The leaf margins are often crenate or irregularly serrated, and the surfaces are sparsely pubescent (Tropical Plants Database, 2023).

1.17.3. Inflorescence and Flowers

The inflorescence is a terminal or axillary corymb of capitula (flower heads) borne on long, slender peduncles. Each capitulum is narrowly cylindrical to bell-shaped, about 6–10 mm long, and consists entirely of tubulate florets, with no ray florets, a typical trait of the genus Emilia. The florets are pink, purple, or mauve, and the involucral bracts are arranged in a single series, green with pale tips (CABI, 2024; Tropical Plants Database, 2023).

1.17.4. Fruit and Seed

The fruit is an achene, slender and about 2 mm long, crowned with a pappus of fine white hairs (about 5 mm) that facilitate wind dispersal. The seeds are light and small, contributing to the species' efficient natural spread across open habitats (GBIF, 2024).

1.17.5. Root System

Emilia praetermissa possesses a fibrous root system, sometimes with a short taproot. The roots enable rapid nutrient uptake and strong anchorage in both cultivated and uncultivated soils. This root structure supports its survival in disturbed lands and during brief dry periods (Adewale *et al.,* 2021).

1.17.6 Reproductive Biology

The plant reproduces sexually through seeds, which germinate readily after the onset of rainfall. Pollination is primarily by small insects, including bees and flies attracted to the brightly colored flower heads. The species completes its life cycle within a single growing season, typical of short-lived herbs in tropical climates (Okunlola *et al.,* 2022).

1.17.7 Distinctive Features

Key identifying features of *Emilia praetermissa* include its:

- Slender, erect, softly hairy stem

- Pink to mauve tubular flower heads without ray florets
- Sessile upper leaves and winged lower petioles
- White feathery pappus aiding seed dispersal

These traits differentiate it from closely related Emilia species such as E. coccinea and E. sonchifolia, which tend to have larger, more vividly colored inflorescences and broader leaf bases (CABI, 2024).

1.8 Taxonomical Classification of *Emilia praetermissa*

The taxonomical classification of *Emilia praetermissa* Milne-Redh. follows the standard hierarchy of plant systematics under the Kingdom Plantae. It belongs to the Asteraceae family, also known as the Compositae, which includes several well-known flowering plants such as sunflowers, daisies, and dandelions. The classification details are as follows:

Classification

Kingdom. Plantae – Plants

Subkingdom. *Tracheobionta* – Vascular plants

Superdivision. *Spermatophyta* – Seed-bearing plants

Division. *Magnoliophyta* – Flowering plants (Angiosperms)

Class. *Magnoliopsida* – Dicotyledons

Subclass. *Asteridae*

Order. *Asterales*

Family. *Asteraceae* – Daisy family

Genus. *Emilia* Cass.

Species *Emilia praetermissa* Milne-Redh.

The genus Emilia Cass. comprises about 50–100 species, many of which are distributed throughout tropical Africa, Asia, and other warm regions. The name Emilia was derived from the Latin term aemulus, meaning "rival" or "emulating," possibly referring to the plant's resemblance to other Asteraceae members (CABI, 2024).

Emilia praetermissa is closely related to E. coccinea (red tassel flower) and E. sonchifolia (lilac tassel flower), but it is distinguished by its smaller pinkish-purple tubular florets, absence of ray florets, and sessile upper leaves. Morphological and genetic studies have confirmed its distinct status within the genus (Okunlola *et al.,* 2022; Tropical Plants Database, 2023).

Taxonomically, *E. praetermissa* was first described by Edgar Wolston Bertram Milne-Redhead (1906–1996), a British botanist known for his extensive work on African flora. The plant's type specimen was collected from tropical Africa, further supporting its African origin (GBIF, 2024).

1.8.1 Common Names of *Emilia praetermissa*

English: Yellow Tassel Flower, Lilac Tassel Flower, Cupid's Shaving Brush

Nigeria (Yoruba): Ewe orinsan, Ewe akoko kekere

Nigeria (Igbo): Inyanya ọkụkọ (sometimes also used for Emilia coccinea)

Nigeria (Hausa): Ruwan biri

Ghana: Sunsum sore

Sierra Leone: African Tassel Flower

General African vernacular: Sometimes called wild lettuce or purple tassel weed due to its appearance.

Figure 1 Emilia praetermissa

Source Google

1.9 Ethnobotanical Uses of *Emilia praetermissa*

Emilia praetermissa Milne-Redh. (family Asteraceae) is widely recognized in African traditional medicine and rural diets for its diverse therapeutic and nutritional applications. Although often regarded as a common weed, it holds significant cultural, medicinal, and nutritional value across several regions of West and Central Africa, particularly in Nigeria, Ghana, Cameroon, Uganda, and the Democratic Republic of Congo (CABI, 2024; Okunlola *et al.,* 2022).

1.9.1 Traditional Medicinal Uses

In ethnomedicine, *Emilia praetermissa* is valued for its anti-inflammatory, antimicrobial, wound-healing, and gastrointestinal protective properties. The plant's leaves, stems, and roots are used in various forms decoctions, infusions, poultices, or fresh leaf applications depending on the ailment and cultural practice (Adewale *et al.,* 2021).

Wound Healing: The fresh leaves are crushed and applied directly on wounds, cuts, and burns to promote healing and prevent infection. This practice is common among local communities in southern Nigeria and parts of Ghana (Okunlola *et al.,* 2022).

Anti-inflammatory and Analgesic Uses: Leaf extracts are used traditionally to alleviate pain and swelling associated with arthritis, abscesses, and muscular injuries (Tropical Plants Database, 2023).

Gastrointestinal Disorders: Decoctions prepared from the leaves are administered to treat stomach aches, ulcers, diarrhea, and dysentery (Adewale *et al.,* 2021).

Respiratory Conditions: In some communities, leaf infusions are taken to relieve cough, asthma, and bronchitis, indicating potential expectorant and bronchodilatory activity (Gbile and Adesina, 2020).

Fever and Malaria: The plant is also used in traditional antipyretic preparations to manage fever and malaria symptoms, either alone or in combination with other herbs (Okunlola *et al.,* 2022).

Reproductive Health: Some rural herbal practitioners employ the plant in the treatment of menstrual irregularities and infertility, though such uses are anecdotal and not yet supported by clinical research (Adewale *et al.,* 2021).

1.9.2 Nutritional and Culinary Uses

In addition to its medicinal roles, *Emilia praetermissa* serves as a wild edible leafy vegetable. The young leaves and tender shoots are cooked and consumed as part of soups, stews, and sauces, particularly during the rainy season when the plant grows abundantly. It is known to contain essential micronutrients such as iron, calcium, magnesium, and vitamins A, C, and E (Okunlola *et al.,* 2022; Adewale *et al.,* 2021).

The plant's mild flavor and tender texture make it a suitable substitute for other indigenous greens like Amaranthus spp. and Solanum macrocarpon. Its inclusion in local diets contributes to food security and micronutrient diversity in low-income rural communities (CABI, 2024).

1.9.3 Other Ethnobotanical Uses

Livestock Feed: The leaves are occasionally fed to small ruminants such as goats and sheep, providing a minor source of forage protein (Tropical Plants Database, 2023).

Soil Restoration: Because of its rapid growth and fibrous roots, *Emilia praetermissa* plays a role in soil stabilization and fertility improvement on fallow or disturbed lands.

Cultural Significance: In some rural Nigerian communities, the plant is symbolically associated with vitality and healing, often featured in herbal mixtures for cleansing or "cooling the body" (Okunlola *et al.,* 2022).

1.10 Pharmacological Activities of *Emilia praetermissa*

Several pharmacological studies have validated the traditional uses of *Emilia praetermissa* as a medicinal plant. Its diverse bioactive compounds including flavonoids, alkaloids, phenolics, tannins, and terpenoids account for its multiple therapeutic effects. The major pharmacological activities are summarized and discussed below:

1.10.1. Anti-inflammatory Activity

The anti-inflammatory property of *E. praetermissa* is one of its most documented pharmacological effects. Ethanolic and methanolic leaf extracts have been shown to inhibit inflammation through suppression of pro-inflammatory cytokines such as TNF-α, IL-1β, and IL-6. The mechanism is linked to the modulation of the cyclooxygenase (COX) and lipoxygenase (LOX) pathways, reducing prostaglandin synthesis (Akinyemi and Omotayo, 2021).

This supports the plant's use in managing pain, arthritis, and inflammatory skin conditions in traditional medicine.

1.10.2. Analgesic (Pain-Relieving) Activity

The analgesic potential of *E. praetermissa* complements its anti-inflammatory role. Studies have shown that methanolic extracts significantly increase pain threshold in experimental models, suggesting central and peripheral mechanisms similar to that of standard analgesics (Oluwole *et al.,* 2023).

Flavonoids and terpenoids are believed to act synergistically by modulating pain receptors and reducing oxidative stress in neuronal tissues.

1.10.3. Antioxidant Activity

E. praetermissa exhibits strong antioxidant and free radical scavenging properties, attributed to its rich content of phenolic acids, flavonoids, and vitamin-like compounds. DPPH and FRAP assays show significant inhibition of oxidative radicals (Oluwole *et al.,* 2023).

This antioxidant capacity helps to protect cells from oxidative damage, suggesting a potential role in preventing chronic diseases like cancer, diabetes, cardiovascular disorders, and neurodegeneration.

1.10.4. Antimicrobial Activity

Extracts of *E. praetermissa* demonstrate broad-spectrum antimicrobial activity against both Gram-positive and Gram-negative bacteria, including Staphylococcus aureus, E. coli, and Pseudomonas aeruginosa (Olabiyi *et al.,* 2020).

The active constituents, mainly alkaloids and phenolics, are known to disrupt microbial cell walls, inhibit enzyme activity, and interfere with nucleic acid synthesis.

This validates its traditional use in treating wound infections, diarrhea, and respiratory ailments.

1.10.5. Antidiabetic and Hepatoprotective Activity

Methanolic extracts of *E. praetermissa* have demonstrated hypoglycemic and hepatoprotective effects. In diabetic rat models, the plant reduced blood glucose levels and improved liver function markers (ALT, AST, and ALP) (Okunlola *et al.,* 2022).

These effects are attributed to the antioxidant and insulin-sensitizing roles of flavonoids and saponins, which help restore normal hepatic metabolism and protect against oxidative liver injury.

1.10.6. Anticancer Activity

Recent studies suggest *E. praetermissa* possesses cytotoxic and antiproliferative properties. Extracts of the plant inhibited the growth of certain cancer cell lines in vitro, likely through the induction of apoptosis (programmed cell death) and suppression of DNA replication (Eze and Ndukwe, 2024).

Although preliminary, these findings provide a promising basis for future development of plant-based anticancer agents.

1.10.7. Other Reported Activities

In addition to the above, *E. praetermissa* has been associated with antipyretic (fever-reducing), wound-healing, and immunomodulatory properties in various ethnomedicinal reports. These actions are consistent with its phytochemical richness and adaptogenic potential.

In summary, the pharmacological properties of *Emilia praetermissa* make it a valuable medicinal plant with potential applications in the management of inflammatory, oxidative, microbial, metabolic, and neoplastic diseases. However, more in-depth toxicological and clinical studies are required to fully establish its safety, dosage, and therapeutic efficacy.

1.11 Vitamins in *Emilia praetermissa*

Although the precise vitamin composition of *Emilia praetermissa* has not yet been comprehensively documented, related species within the Emilia genus—such as Emilia sonchifolia and Emilia coccinea—have been widely reported to contain appreciable levels of essential vitamins. Given their close botanical and phytochemical similarity, *E. praetermissa* is expected to exhibit a comparable vitamin profile, particularly rich in vitamins A (provitamin A carotenoids), C (ascorbic acid), E (tocopherols), and several B-complex vitamins.

1.11.1Vitamin A (Provitamin A Carotenoids)

Leafy members of the Emilia genus contain high concentrations of β-carotene, the precursor of vitamin A. Vitamin A is crucial for vision, immune function, and epithelial tissue maintenance. Studies on Emilia sonchifolia and E. coccinea revealed β-carotene contents ranging from 1.5–3.2 mg/100 g fresh weight, levels comparable to those found in spinach and amaranth (Oluwole *et al.,* 2023; Akubugwo *et al.,* 2019).

Given the similar pigmentation and phytochemical structure, *E. praetermissa* likely exhibits a moderate to high vitamin A potential, making it a useful source of provitamin A for rural diets.

1.11.2 Vitamin C (Ascorbic Acid)

Vitamin C is one of the most abundant water-soluble antioxidants in green leafy plants. It plays a central role in collagen synthesis, iron absorption, immune defense, and free radical scavenging. Research on Emilia sonchifolia has shown vitamin C levels ranging between 22 – 38 mg/100 g FW (Olabiyi *et al.,* 2020). Since *E. praetermissa* also demonstrates strong antioxidant activity in DPPH and FRAP assays, the presence of vitamin C is strongly indicated.

Thus, it likely contributes significantly to the total antioxidant capacity of the plant and could serve as a natural source of vitamin C in traditional diets.

1.11.3 Vitamin E (Tocopherols)

Vitamin E (α-tocopherol) acts as a lipid-soluble antioxidant, protecting cell membranes from oxidative stress and supporting reproductive health.

Although direct tocopherol quantification for *E. praetermissa* is unavailable, its oil fraction and phenolic composition suggest that tocopherols are present, as demonstrated in other Asteraceae members (Oluwole *et al.,* 2023).

This antioxidant synergy of vitamin E with carotenoids and polyphenols further enhances the plant's free-radical neutralizing potential.

1.11.4 B-Complex Vitamins (B_1, B_2, B_3, B_6, B_9)

B-vitamins serve as cofactors in energy metabolism, red-blood-cell formation, and nervous-system function. Studies on related wild leafy vegetables report notable amounts of thiamine (B_1), riboflavin (B_2), and niacin (B_3) ranging from 0.02 – 0.3 mg/100 g FW (Effiong *et al.,* 2024).

Because *E. praetermissa* grows in similar agro-ecological conditions and shares metabolic traits with these species, it likely contains a comparable B-vitamin spectrum.

These vitamins may contribute to the nutritional and functional food value of the plant, especially in low-income communities that depend on wild greens for micronutrients.

The combination of these vitamins provides *E. praetermissa* with strong nutraceutical potential. Vitamins A, C, and E form an antioxidant triad, mitigating oxidative stress and cellular aging, while the B-complex group supports metabolic energy and neurological health.

Thus, integrating *E. praetermissa* into local diets could help combat micronutrient deficiencies such as vitamin A deficiency and scurvy, which remain public-health concerns in developing regions.

1.12 Mineral Composition of *Emilia praetermissa*

Minerals are indispensable micronutrients that function as cofactors, structural components, and regulatory elements in virtually all biological systems. Although required in small quantities, they are crucial for maintaining homeostasis, metabolic integrity, and enzyme function. *Emilia praetermissa*, a member of the Asteraceae family, is an underutilized indigenous leafy vegetable that has gained increasing attention for its nutritional and medicinal significance. Studies on related species such as Emilia sonchifolia and Emilia coccinea have revealed high levels of essential minerals, indicating that *E. praetermissa* may also serve as a valuable source of both macro- and microminerals (Effiong *et al.,* 2024; Adeyeye and Adesina, 2024).

1.12.1 Calcium (Ca)

Calcium is the most abundant mineral in the human body and plays multiple physiological roles beyond skeletal formation. It regulates nerve transmission, muscle contraction, intracellular signaling, and hormone secretion. *E. praetermissa*, like many green vegetables, accumulates calcium in its cell walls and vacuoles, making it an important dietary source of this mineral (Effiong *et al.,* 2024). In populations with limited access to dairy products, the consumption of calcium-rich vegetables can help prevent hypocalcemia, osteoporosis, and rickets. Moreover, calcium interacts synergistically with phosphorus to strengthen bones and teeth. The adequate intake of calcium from plant sources is also associated with reduced risks of hypertension and colon cancer due to its role in regulating vascular tone and cell differentiation (Ogunlade *et al.,* 2021).

1.12.2 Iron (Fe)

Iron is a vital trace element essential for hemoglobin synthesis, oxygen transport, energy metabolism, and cellular respiration. It exists in two main forms: heme (from animal sources) and non-heme (from plants). Although non-heme iron is less bioavailable, the presence of vitamin C and organic acids in *E. praetermissa* may enhance its absorption (Alam *et al.,* 2009). Iron deficiency remains a global public health concern, causing anemia, fatigue, and impaired cognitive development, particularly in children and women of reproductive age. The reported high iron levels in Emilia species suggest that *E. praetermissa* can help mitigate iron-deficiency anemia in vulnerable populations (Adeyeye and Adesina, 2024).

1.12.3 Potassium (K)

Potassium serves as the main intracellular cation, crucial for maintaining osmotic balance, acid-base regulation, and neuromuscular activity. It works antagonistically with sodium to regulate blood pressure and heart rate. Diets high in potassium are known to reduce the risk of stroke and cardiovascular diseases. The potassium content of *Emilia praetermissa* adds to its nutritional value as a natural blood pressure regulator and electrolyte restorer, especially beneficial in hot climates where fluid loss is common (Effiong *et al.,* 2024). Furthermore, potassium supports carbohydrate metabolism and the synthesis of glycogen, thereby enhancing energy availability in body tissues.

1.12.4 Magnesium (Mg)

Magnesium is the fourth most abundant cation in the body and acts as a cofactor in over 300 enzyme systems involved in energy production, protein synthesis, and glucose metabolism. It stabilizes DNA, RNA, and ATP structures and contributes to normal muscle and nerve function. The presence of magnesium in *Emilia praetermissa* enhances its nutritional value as it supports cardiac rhythm regulation, insulin sensitivity, and muscle relaxation. Deficiency in magnesium can lead to neuromuscular irritability, fatigue, and an increased risk of metabolic syndrome (Adeyeye and Adesina, 2024). Its interaction with calcium also contributes to maintaining electrical potential across cell membranes.

1.12.5 Zinc (Zn)

Zinc is a trace element required for immune modulation, wound healing, cell division, and reproductive health. It is a key component of numerous metalloenzymes, such as carbonic anhydrase and alcohol dehydrogenase. In plants, zinc contributes to chlorophyll formation and enzyme activation, while in humans, it regulates gene expression and DNA synthesis. The zinc content of *E. praetermissa* could therefore contribute to improving immune responses and fertility in zinc-deficient individuals. Prolonged deficiency can result in stunted growth, alopecia, dermatitis, and reduced appetite (Effiong *et al.,* 2024). Additionally, zinc interacts with copper and iron in enzymatic pathways, emphasizing the need for balanced mineral intake.

1.12.6 Manganese (Mn)

Manganese functions as a cofactor for enzymes involved in amino acid, lipid, and carbohydrate metabolism. It is also part of the antioxidant enzyme manganese superoxide dismutase (MnSOD), which protects mitochondria from oxidative damage. In *E. praetermissa*, manganese likely contributes to the plant's strong antioxidant properties and may play a role in wound healing and tissue regeneration (Akyuz *et al.,* 2010). Inadequate manganese intake may impair skeletal growth, alter glucose tolerance, and reduce fertility.

1.12.7 Sodium (Na)

Sodium is an essential extracellular electrolyte responsible for maintaining osmotic pressure, acid-base balance, and electrical excitability in nerves and muscles. Although excessive sodium intake is linked with hypertension, moderate amounts are necessary for physiological function. The natural sodium levels in *E. praetermissa* are expected to be within the safe range, supporting fluid balance without contributing to hypertensive risks (Ogunlade *et al.,* 2021). The balance between sodium and potassium in the plant enhances its suitability for cardiac and renal health.

1.12.8 Copper (Cu)

Copper plays a key role in iron metabolism, connective tissue synthesis, and the formation of hemoglobin. It is a component of several redox enzymes, including cytochrome c oxidase, ceruloplasmin, and lysyl oxidase. Copper deficiency can result in anemia, bone abnormalities, and cardiovascular disorders. The moderate copper levels expected in *E. praetermissa* enhance its contribution to red blood cell production and oxidative defense mechanisms (Adeyeye and Adesina, 2024). Furthermore, copper interacts with zinc and iron in antioxidant systems, ensuring redox balance.

1.12.9 Phosphorus (P)

Phosphorus is a major constituent of bones, teeth, phospholipids, and nucleic acids. It participates in energy metabolism through its role in ATP and GTP synthesis and in cellular signal transduction via phosphorylation reactions. The phosphorus in *Emilia praetermissa* contributes to energy balance, cell membrane integrity, and acid-base regulation. A deficiency in phosphorus can cause muscle weakness, poor bone mineralization, and reduced growth. When consumed along with calcium, it promotes skeletal health and structural strength (Ogunlade *et al.,* 2021).

1.12.10 Selenium (Se)

Selenium is a powerful antioxidant that forms part of selenoproteins such as glutathione peroxidase, which prevents oxidative damage to lipids and DNA. Selenium also supports thyroid hormone metabolism and immune defense. Although present in trace quantities, adequate selenium intake helps reduce the risk of cardiovascular diseases, infertility, and certain cancers (Adeyeye and Adesina, 2024). The potential presence of selenium in *Emilia praetermissa* adds to its pharmacological relevance, particularly in preventing oxidative stress–related disorders.

1.12.11 Environmental and Biological Influences

The mineral profile of *E. praetermissa* is influenced by several factors, including soil mineral composition, pH, organic matter, agroecological zone, and harvesting season. Leafy vegetables grown in mineral-rich soils typically exhibit higher elemental concentrations. Processing methods such as drying, blanching, and fermentation also affect mineral retention and bioavailability. Additionally, the presence of anti-nutrients such as phytates and oxalates can chelate minerals like calcium, zinc, and iron, reducing their absorption. However, traditional preparation methods such as boiling or fermenting can lower anti-nutrient levels, improving mineral bioavailability (Ogunlade *et al.,* 2021).

In summary, *Emilia praetermissa* possesses a diverse and nutritionally relevant mineral composition that supports its dual role as a food and medicinal plant. Its richness in calcium, iron, potassium, and magnesium underscores its potential in combating micronutrient deficiencies and promoting overall metabolic health. Trace elements such as zinc, copper, and selenium further enhance its antioxidant and immunomodulatory properties. The integration of *E. praetermissa* into diets could therefore provide a sustainable means of improving nutritional status, particularly in communities where mineral deficiencies are prevalent.

CHAPTER TWO

MATERIALS AND METHODS

2.1 Materials

Equipment and Instruments

Analytical weighing balance (PA213) OMAUS Corp. Pioneer, U.S.A

Beakers (10ml, 50ml, 100ml, 250ml) (Pyrex, England)

Burette (100ml,200ml,500ml,1000ml) (Pyrex, Englan)

Conical flask (100ml,200ml,500ml) (Pyrex, England)

Cotton wool ()Royal lint, England

Desiccator (Thermo Fisher Scientific, USA)

Disposable gloves (Unigloves, Nigeria.)

Eppendorf tubes (Tower Group Ltd, Nigeria)

Foil paper (Tower Group Ltd, Nigeria.)

Gas chromatography-flame ionization detector. (Thermo Fisher Scientific, USA(GC-FID)

Gas chromatography-mass spectrometry (Thermo Fisher Scientific, USA(GC-MS)

Hammer mill machine (Varahi Industries, India.)

High-performance liquid chromatography (Thermo Fisher Scientific, USA)(HPLC)

Hand glove (Den-V Glove, Nigeria)

Hot plate (Qasa, Nigeria)

Magnetic stirrer (79-1) (JINOTECH Instruments, China)

Measuring cylinder (Pyrex, England)

Micro pipette (Erba Lachemas Brno, Czech Republic)

Mortar and pestle (United Scientific, USA)

Muffle furnace(Nabertherm, Lilienthal, Germany)

Muslin cloth (Jante Textile, Turkey)

Oven (DHG 90 30A) (Hinoteck, China.)

Pasteur pipette (Alpha Laboratories Ltd, U.K.)

Pipette (5mls, 10mls) (Pyrex, England)

Plastic containers (4L calibration) (OK plastics, Nigeria)

Refrigerator (HA-137) (Haier Thermocool, Nigeria)

Separating funnel (Pyrex, England)

Soxhlet extractor (Pyrex, England)

Spectrophotometer (20D S23A) (Teckmel and Teckmel, U.S.A)

Test tubes (Pyrex, England)

Test tubes racks (Equitron Medica Instruments, India)

Thimble (Dritz Corporation, South Carolina)

UV-visible spectrophotometer (Thermo Fisher Scientific, USA)

Vortex XH-B (Hinoteck China)

Whatman filter paper

2.2 Reagents

Absolute ethanol (G.G. Chemical Factory Ltd.Guangdua, China.)

Acetic anhydride (Sigma-Aldrich, Germany)

Acetone (Merck, Germany)

Ammonia (Yara, Brazil)

Ammonium hydroxide (Hibrett Puratex)

Ammonium molybdate tetrahydrate (Otto Chemie Pvt, Ltd. Mumbai.)

Ammonium thiocyanate (Jigs Chemical Ltd, India)

Ascorbic acid (Brenntag Chemicals Ltd, Nigeria.)

Benzene (Sinopec Group, China)

Calcium sulphate (Vishnupriya, India)

Chloroform (Fisher Chemical)

Citric acids (BDH, Poole England)

Copper (II) sulphate (Wego Chemical Group, USA)

Diethyl ether (Arihant Chemical Industries, India)

Distilled water (BCH Research Lab, UNIBEN)

EDTA (Ethylene diamine tetraacetic acid)(Turraco Industrial Ltd, Nigeria).

Ferric chloride (Haihang Industry, Co. Ltd, China.)

Ferrous sulphate (Haihang Industry, Co. Ltd, China).

Gallic acid (Dalian Chem, China)

Glacial acetic acid (Fengbai, China)

Hydrochloric acid (concentrated) (Brenntag Chemicals Ltd, Nigeria.)

Hydrogen cyanide (Cornerstone Chemica, Louisiana)

Hydrogen peroxide (Brenntag Chemicals Ltd, Nigeria.)

Local gin , Nigeria (Uselu, Benin City, Nigeria)

Methanol (BDH, England)

Methyl red (British Drug House Chemicals Ltd, Poole England)

Nitric acid (concentrated) (Yara, Brazil)

Olive oil (Goya, Spain)

Sodium carbonate. (Danto Chemicals Ltd, Nigeria)

Sodium citrate (Citrique Belge, Tienen, Belgium)

Sodium hydrogen carbonate (Brenntag Chemicals Ltd, Nigeria)

Sodium hydroxide (Brenntag Chemicals Ltd, Nigeria)

Sodium nitrite (BDH, Poole England)

Sulphuric acid (concentrated) (British Drug House Chemicals Ltd, Poole, England.)

Petroleum ether (Joshi Agrochem Pharma Pvt Ltd, Mumbia, India)

Potassium ferrocyanide [K3Fe(CN)6] (Vizag Chemical, India)

Potassium permanganate (Niken Chemical Company, India)

Potassium thiocyanate (Sigma-Aldrich, Germany)

Trichloroacetic acid (TCA) (Spectrum chemical, USA)

2,2- diphenyl-1-picryl-hydrazyl(DPPH) powder (Sigma-Aldrich, Germany)

2,4,6- Tris(2pyridyl)-s-triazine(DPPH) powder(Sigma-Aldrich, Germany)

2.3 Sample collection and authentication

Fresh *Emilia praetermissa* Milne-Redh leaves were gathered from the Okhun community and the University of Benin, both located in the Ovia North East Local Government Area in Benin City, Edo State, Nigeria.

Prof. Henry Adewale Akinnibosun identified the leaves at the Department of Plant Biology and Biotechnology, Herbarium Unit, University of Benin, Benin City, and provided the voucher code UBH-E407 for reference.

2.4 METHODS

2.4.1Extraction

Fresh *Emilia praetermissa* leaves were thoroughly cleaned of sand and allowed to dry in the open for five (05) days at room temperature (24°C to 27°C). A dry hammer mill (Varahi Industries, India) was used to grind the dried leaves. A precise 150g portion of the ground-up sample (plant material) was weighed and macerated with 3.5L of distilled water for 48 hours, stirring occasionally. The resulting extract was put in a sanitized plastic container after being filtered through muslin cloth and Whatman No. 1 filter paper.After mixing another ground sample with 3.5L of local gin, the same procedure was followed for the water. The filtrates were then concentrated using freeze drying (aqueous extract) and a rotary evaporator (local gin extract). After that, the extracts were weighed. The extracts were then kept at 4°C in sterile containers until they were needed.

2.5 Animal Study

2.5.1 Experimental Animals

Emilia praetermissa extracts were studied in Wister rats (6–8 weeks old, 80–100 g). The animals were housed under standard laboratory conditions (12-hour light/dark cycle, 20–26oC), with free access to food and water, and were acclimatized for 7 days prior to the experiment. Doses of the extracts were administered orally, and the animals were observed for 28 days for signs of toxicity or mortality, following OECD guidelines. Ethical approval was obtained before the study, and all procedures were carried out in compliance with internationally accepted standards for the humane treatment of laboratory animals.

2.5.2 Experimental design

Animal grouping

Four groups of six rats each were randomly selected from among the rats (n=6). Only the vehicle solution was given to Group 1, which acted as the control. The *Emilia praetermissa* extract was administered orally to groups 2, 3, and 4 in increasing doses (e.g., 300 mg/kg, 1000 mg/kg, and 2000 mg/kg body weight, respectively). The evaluation of dose-dependent effects on antioxidant potential and toxicity parameters was made possible by this grouping. Over the course of 28 days, each group was observed separately to track clinical signs, behavioral changes, and mortality.

2.5.3 Measurement of body weight

Following the acclimatization period, the body weight of each rat was measured once a week. This aided in figuring out the right dosage of *Emilia praetermissa* extract and tracking any weight changes brought on by its administration.

2.5.4 Acute Toxicity Studies

Two phases of acute toxicity assessment were carried out using a modified version of Lorke's methodology (1983):

Phase 1: Oral administration of extract at doses of 10 mg/kg, 100 mg/kg, and 1000 mg/kg body weight was administered to six rats per extract type (local gin and water) in two groups of three animals each. Over the course of a day, the animals were monitored for signs of toxicity and death.

Phase 2: Six rats of each extract type received oral doses of 1600 mg/kg, 2900 mg/kg, and 5000 mg/kg body weight of extract, respectively, based on the results of Phase 1. The animals' behavior and mortality were monitored for a full day.

Calculation:

LD50 = $\sqrt{D0 \times D100}$

Where;

LD50 = Lethal dose

D0 = highest dose that gave no mortality

D100 = lowest dose that produced mortality

2.5.6 Experimental animals

Adult male Wistar rats, weighing between 85-110g, were obtained from the institutional animal facility. The animals were housed in standard cages under controlled laboratory conditions (temperature 22-25°C, 12-hour light/dark cycle, relative humidity 45-55%). All animals underwent acclimatization for a one-week period prior to experimentation and had unrestricted access to standard rodent feed and water ad libitum.

2.5.7 Experimental design

The investigation was performed over four weeks utilizing the aqueous extract. Rats were randomly allocated into four groups:

Group Control: Received normal saline

Group A: Received 100 mg/kg body weight of the extract

Group B: Received 250 mg/kg body weight of the extract

Group C: Received 500 mg/kg body weight of the extract

Body weights were recorded weekly throughout the study duration.

2.6 Blood Collection

Blood samples were collected at weeks 1, 2, 3 and 4 via cardiac puncture under light anesthesia. Samples were separated into two portions: one for haematological analysis and the other centrifuged at 3000rpm for 15 minutes to obtain serum for liver function tests. Blood samples for haematological analysis was collected into containers while that for biochemical analysis into plain tubes .

2.7 Organ collection

At the conclusion of each experimental period, animals were euthanized under anesthesia. The liver, heart, and kidneys were meticulously excised, cleaned of adhering tissues, and weighed. Relative organ weights were computed as a percentage of body weight.

2.8 Determination of mineral content

Principle: The determination of mineral content is based on the conversion of all mineral elements present in the sample into inorganic ash, followed by quantitative analysis using appropriate instrumental or titrimetric methods. The dried sample is first incinerated in a muffle furnace at high temperature (550°C) to oxidize and remove all organic matter, leaving behind an ash residue composed of the mineral constituents. The ash is then dissolved in a suitable acid, usually nitric or hydrochloric acid, to bring the minerals into solution. The concentrations of individual minerals (such as calcium, magnesium, potassium, sodium, iron, zinc, etc.) are then determined using techniques such as atomic absorption spectrophotometry (AAS), inductively coupled plasma optical emission spectrometry (ICP-OES), flame photometry, or colorimetric methods.

Procedure: The samples was oven-dried at 105°C for 2 hours, then ground into fine particles using a mortar and pestle. A 0.2g sample was mixed with 1mL of concentrated nitric acid and

3mL of concentrated HCl in a conical flask and heated. After heating, 10mL of distilled water was added, and heating continued until the sample became colorless. The solution was cooled, diluted with 10mL of distilled water, filtered into a 100mL volumetric flask using Whatmann No. 1 filter paper , and made up to the mark with distilled water.

Calculation:

$$\text{Mineral content (mg/100 g sample)} = \frac{C \times V \times DF}{W} \times 100$$

Where:

C = Concentration of the mineral from ICP-OES reading (mg/L or ppm)

V = Final volume of the mineral solution after dilution (L)

DF = Dilution factor (if further dilutions were made before analysis)

W = Weight of the sample used for ashing (g, dry weight basis)

2.9 Vitamin Determination

Vitamins B1 (Thiamine), B2 (Riboflavin) and B3 (Niacin) were estimated based on the method of (Okwu and Josiah, 2006). Vitamin C (ascorbic acid) and vitamin A (retinol) were determined according to the method outlined by Adegbaju, *et al*. (2019). All the analysis were carried out in three (3) replicates. The other vitamins were determined using GC-MS.

Principle: Gas Chromatography–Mass Spectrometry (GC–MS) combines the separating power of gas chromatography with the molecular identification capability of mass spectrometry for the qualitative and quantitative determination of compounds such as vitamins. In this method, the sample is vaporized and carried by an inert gas (e.g., helium) through a chromatographic column, where individual components are separated based on their volatility and interaction with the column's stationary phase. As each compound elutes from the column, it enters the mass spectrometer, where it is ionized, fragmented, and detected according to its mass-to-charge ratio (m/z). The resulting mass spectrum provides a unique "fingerprint" for compound identification, while the chromatographic peak area is used for quantification by comparison with calibration standards. GC–MS is particularly suitable for vitamins that are volatile or can be derivatized into volatile forms, allowing sensitive and specific analysis in complex matrices (Sneddon *et al.,* 2007).

CHAPTER THREE

RESULTS

3.1 Results showing the mineral analysis micro-nutrient present in *Emilia praetermissa*

Mineral Composition	Micro-nutrient values
Potassium (K)	19.60 mg/L
Sodium (Na)	8.60 mg/L
Magnesium (Mg)	1.46 mg/L
Iron (Fe)	0.20 mg/L
Copper (Cu)	0.18 mg/L
Manganese (MN)	2.90 mg/L
Zinc (Zn)	0.73 mg/L
Chromium (Cr)	0.50 mg/L
Phosphorus (P)	51.47 mg/L
Calcium (Ca)	24.60 mg/L

The mineral analysis of *Emilia praetermissa* indicates that the plant contains a range of essential macro- and micro-nutrients. Phosphorus (51.47 mg/ L) and calcium (24.60mg/L) are the most abundant minerals, the relatively high phosphorus and calcium content indicates that the plant could support skeletal health and metabolic processes such as energy transfer and cell signaling.Potassium (19.60 mg/L) and sodium (8.60 mg/L) are present at moderate levels, the moderate potassium and sodium levels suggest potential benefits for maintaining osmotic balance and proper nerve and muscle function. Magnesium (1.46 mg/L), manganese (2. mg/L), zinc (0.73 mg/ L), iron (0.20 mg/L), copper (0.18 mg/L), and chromium (0.50 mg/ L) are present in smaller quantities, these trace elements like manganese, zinc, copper, iron, and chromium, though present in low concentrations, are vital for enzymatic activities, antioxidant defense, and glucose metabolism. Overall, the results suggest that *E. praetermissa* could serve as a supplementary source of essential minerals, particularly for populations at risk of micronutrient deficiencies, while also supporting general metabolic and physiological functions.

3.2 Results showing the Vitamin Concentration in the plant *Emilia praetermissa*.

The vitamin concentration values were done in triplicate and are shown in the table below in the Standard Error of mean (SEM).

Compound (Vitamin mg%)	**Concentration**
Vitamin A	9.99+0.53
Vitamin B1	2.80+0.52
Vitamin B2	2.62+0.62
Vitamin B3	0.34+0.04
Vitamin C	14.41+1.63
Vitamin E	6.35+0.67

The vitamin analysis of *Emilia praetermissa* indicates that it contains significant amounts of both water- and fat-soluble vitamins. Vitamin C is the most abundant at 14.41 mg%, highlighting the plant's strong antioxidant potential which may help in preventing oxidative stress-related diseases and boosting immune function and collagen synthesis. Vitamin A, present at 9.99 mg%, is important for vision, skin health, epithelial tissue integrity, and immune function. Vitamin E, at 6.35 mg%, contributes to antioxidant defense and protecting cells from lipid peroxidation and maintaining cardiovascular health. B-vitamins are also present in moderate amounts, with B1 (2.80 mg%), B2 (2.62 mg%), and B3 (0.34 mg%) supporting energy metabolism, nerve function, and overall cellular activity. Collectively, these results highlight *E. praetermissa* as a nutrient-dense plant capable of supporting antioxidant defense, metabolic processes, and overall physiological well-being.

CHAPTER FOUR

DISCUSSION AND CONCLUSION

4.1 Discussion on the Mineral analysis of *Emilia praetermissa.*

The mineral analysis of *Emilia praetermissa* demonstrates that it contains a diverse range of essential macro- and micro-nutrients, highlighting its potential nutritional and therapeutic value. Phosphorus, present at 51.47 mg/L, is crucial for the formation of bones and teeth, energy metabolism, and nucleic acid synthesis, suggesting that the plant may support both skeletal and cellular health (Soetan *et al.,* 2010). Calcium, at 24.60 mg/L, plays a vital role in bone strength, muscle contraction, and nerve function, indicating that consumption of *Emilia praetermissa* may contribute to maintaining skeletal integrity and neuromuscular function (Soetan *et al.,* 2010).

Potassium, measured at 19.60 mg/L, and sodium, at 8.60 mg/L, are essential for maintaining electrolyte balance, proper nerve transmission, and muscle function. Adequate levels of these minerals help regulate fluid balance, cardiovascular function, and overall physiological homeostasis (Soetan *et al.,* 2010). Magnesium, present at 1.46 mg/ L, is a cofactor for over 300 enzymatic reactions in the body, including protein synthesis and nerve signaling, demonstrating that *E. praetermissa* may support metabolic and physiological processes (Soetan *et al.,* 2010). Trace elements in the plant, including manganese (2.90 mg/L), zinc (0.73 mg/L), copper (0.18 mg/L), iron (0.20 mg/L), and chromium (0.50 mg/L), are critical for enzymatic activity, antioxidant defense, glucose metabolism, and immune function. Manganese contributes to bone formation, metabolism, and antioxidant defense, while zinc is necessary for immune response, protein synthesis, and wound healing. Copper supports iron metabolism and connective tissue formation, iron facilitates oxygen transport through hemoglobin and myoglobin, and chromium enhances insulin action and glucose regulation (Soetan *et al.,* 2010).

Overall, the mineral profile of *Emilia praetermissa* suggests that it is a valuable source of essential nutrients. The high levels of phosphorus and calcium support bone and cellular health, moderate amounts of potassium and sodium aid in neuromuscular function, magnesium contributes to enzymatic and metabolic processes, and trace elements enhance immunity and antioxidant defenses. These characteristics indicate that the plant has potential applications in nutrition, metabolic support, and overall health maintenance (Soetan *et al.,* 2010).

4.2 Discussion on the vitamin analysis of *Emilia praetermissa*.

The vitamin analysis of *Emilia praetermissa* demonstrates that the plant is a rich source of both water- and fat-soluble vitamins, which are essential for maintaining various physiological processes. Vitamin C, present at 14.41 mg%, is particularly abundant, suggesting strong antioxidant properties. Vitamin C not only helps neutralize free radicals and reduce oxidative stress, but it also plays a key role in collagen synthesis, wound healing, iron absorption, and immune system support (Carr and Frei, 1999; Pullar *et al.,* 2017).

Vitamin A, measured at 9.99 mg%, is critical for visual health, especially night vision, as well as for maintaining healthy epithelial tissues, skin, and mucosal barriers. Adequate intake of vitamin A also enhances immune function and helps prevent deficiency-related disorders, such as xerophthalmia (Sommer and West, 1996; West, 2002). Vitamin E, present at 6.35 mg%, functions as a lipid-soluble antioxidant, protecting cellular membranes from oxidative damage, reducing lipid peroxidation, and potentially lowering the risk of chronic diseases, including cardiovascular disorders (Traber and Atkinson, 2007; Brigelius-Flohé and Traber, 1999).

The B-vitamins in *E. praetermissa*, including B1 (2.80 mg%), B2 (2.62 mg%), and B3 (0.34 mg%), play pivotal roles in energy metabolism by acting as coenzymes in carbohydrate, fat, and protein metabolism. Vitamin B1 (thiamine) is important for nerve function and glucose metabolism, B2 (riboflavin) contributes to energy production and antioxidant defense, and B3 (niacin) supports DNA repair, enzymatic reactions, and cellular respiration (Kennedy, 2016; O'Leary and Samman, 2010). These B-vitamins also help maintain healthy skin, hair, and neurological function.

Overall, the vitamin profile of *Emilia praetermissa* indicates that the plant is highly nutrient-dense, providing strong antioxidant protection, supporting immune function, promoting metabolic efficiency, and enhancing overall physiological well-being. The combination of high vitamin C, significant vitamin A and E, and moderate B-vitamins suggests that *E. praetermissa* can serve as a functional food or natural supplement for improving health and preventing micronutrient deficiencies.

Emilia praetermissa is rich in essential minerals and vitamins, making it a valuable nutrient source. It contains high levels of phosphorus (51.47 mg/L) and calcium (24.60 mg/L) for bone health, moderate potassium (19.60 mg/L) and sodium (8.60 mg/L) for electrolyte balance, magnesium (1.46 mg/L) for enzymatic and nerve functions, and trace elements like manganese, zinc, copper, iron, and chromium that support metabolism, antioxidant defense, and immunity (Soetan *et al.,* 2010). The plant is also a good source of vitamins, with vitamin C (14.41 mg%) providing antioxidant and immune support, vitamin A (9.99 mg%) and E (6.35 mg%) aiding vision, skin, and cellular protection, and B-vitamins (B1, B2, B3) supporting energy metabolism and nervous system function (Carr and Frei, 1999; Kennedy, 2016; Traber and Atkinson, 2007).

Overall, the combined mineral and vitamin profile highlights *E. praetermissa* as a functional food capable of supporting general health and preventing nutrient deficiencies.

CONCLUSION

Emilia praetermissa is a highly nutrient-dense plant, containing a well-balanced profile of essential minerals and vitamins that make it valuable for both nutritional and therapeutic purposes. Its high concentrations of phosphorus and calcium support bone formation, skeletal integrity, and vital metabolic processes, while moderate levels of potassium, sodium, and magnesium contribute to maintaining electrolyte balance, nerve conduction, muscle contraction, and enzymatic activity. The presence of trace elements such as manganese, zinc, copper, iron, and chromium further enhances its nutritional value by supporting antioxidant defense systems, oxygen transport, immune function, and glucose metabolism. In terms of vitamins, the plant is particularly rich in vitamin C, which provides strong antioxidant and immune-supporting effects, while vitamins A and E contribute to vision, skin and mucosal health, and protection against cellular oxidative stress. The B-vitamins (B1, B2, and B3) play critical roles in energy metabolism, enzymatic reactions, and nervous system function. Together, the combination of minerals and vitamins positions *E. praetermissa* as a functional food capable of improving overall health, preventing micronutrient deficiencies, supporting metabolic efficiency, and potentially reducing the risk of chronic diseases associated with oxidative stress and nutritional insufficiencies. This nutritional richness highlights the plant's potential for inclusion in dietary interventions, nutraceutical formulations, and as a natural supplement to enhance physiological well-being.

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