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NUTRITIONAL AND ANTIOXIDANT PROFILE OF *BRYOPHYLLUM PINNATUM* LEAF EXTRACTS

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ABSTRACT

Kalanchoe pinnata also known as *Bryophyllum pinnatum* is a plant that has a lot of phytochemicals and is thought to have therapeutic properties. Scientists are interested in it because it is used a lot in traditional medicine. This study assessed the vitamin profile, antioxidant activity, and mineral content of *B. pinnatum* leaf extract. Fresh leaves were gathered, verified, air-dried, and subsequently extracted using ethanol. Standard spectrophotometric assays utilised to evaluate antioxidant activity comprised superoxide dismutase (SOD), catalase (CAT), glutathione (GSH), peroxidase (POD), DPPH radical scavenging, and ferric reducing antioxidant power (FRAP). Atomic Absorption Spectrophotometry was used to look at the mineral content, while spectrophotometric and titrimetric methods were used to look at the vitamin content. Vitamin B3 had the lowest concentration (0.038 mg/g), whereas vitamins C and K had the highest quantities (195.74 mg/100 g and 132 mg/100 g, respectively). The extract showed strong antioxidant activity, especially with FRAP at 67.13 mg/g and DPPH scavenging at 87.80%. There were also a lot of important minerals in it, like iron, calcium, potassium, and salt. The results show that B. pinnatum has important nutritional and antioxidant qualities, which suggests that it could be used as a functional food and a treatment for illnesses connected to oxidative stress.

KEYWORDS: *Kalanchoe pinnata*, antioxidant activity, phytochemicals, vitamins, mineral composition, medicinal plants.

INTRODUCTION

Kalanchoe pinnata, also known as *Bryophyllum pinnatum* and sometimes known as the Life Plant or Miracle Plant, has been utilized in traditional medicine (Nwadinigwe, 2011). The majority of the plants in the genus *Kalanchoe* are used as medicines to treat a variety of diseases. It has long been recognized that plants in this genus have medicinal potential, and scientists have long been interested in them. The Crassulaceae family includes *Kalanchoe pinnata* (also known as *Bryophyllum pinnatum*), which is also referred to as "Miracle Leaf," "Cathedral Bells," "Air plant," "Life plant," "Goethe plant," "Wonder of the World," and other names. Because new plantlets may be separated from the mom and grown separately on pots or barren lands, it is also known as the "Mother of Thousand" (Kaur *et al.*, 2014). Recent work has renewed interest in its flavonoids, phenolic acids, and terpenoids that may activate antioxidant responses, suppress pro-inflammatory mediators, and limit apoptosis. Modern extraction and quality control methods help standardize active constituents across batches. Reports since 2020 describe antioxidant, anti-inflammatory, antimicrobial, and in some settings hepatoprotective activity, including beverage-grade leaf extracts tested in rat models of chemical injury (Anandan *et al.*, 2024. Saeed *et al.*, 2025). In traditional medicine, various parts of *Kalanchoe pinnate* are used for the treatment of ailments such as wounds, ulcers, infections, inflammation, and liver disorders (Saha *et al.*, 2019). The plant is known to contain a wide range of bioactive compounds, including flavonoids, bufadienolides, phenolic acids, glycosides, and triterpenes, which collectively contribute to its pharmacological effects (Nayak *et al.*, 2016; Saha *et al.*,

2019). Many plants have been used for the treatment of illnes in traditional system of medicine throughout the world. Indeed along with the dietary measures, plant preparation formed the basis of the treatment of the disease until the introduction of allopathic medicine. Traditional knowledge will serve as a powerful search engine and most importantly, will greatly facilitate intentional, focused and safe natural products research to rediscover the drug discovery process, Iboyi and Adebayo, 2021.

MATERIALS AND METHODS

Sample Collection

Fresh leaves of *Kalanchoe pinnata* were harvested from Ibusa, Delta State, Nigeria. The specimen was authenticated at the Botany Department, Nnamdi Azikiwe University, Awka, and assigned Herbarium Number NAUTH–172A. The collected leaves were thoroughly washed, shade-dried, ground into powder, and stored aseptically.

Plant Extraction

To obtain the extract, 500 grams of powdered leaves were soaked in 1.5 litres of ethanol for 48 hours. This mixture was then filtered, and the filtrate concentrated using a rotary evaporator. The resulting extract was stored at low temperature until further assessment. Antioxidant activity assays were performed using established spectrophotometric techniques, including superoxide dismutase (SOD), catalase (CAT), glutathione (GSH), and peroxidase (POD) evaluations, as well as DPPH radical scavenging and ferric reducing antioxidant power (FRAP) assays, as described by Benzie & Strain (1999) and Gülçin & Alwasel (2023).

Vitamin Analysis

B-complex and fat-soluble vitamins (A, D, E, and K) were quantified using spectrophotometric and titrimetric methods at their respective wavelengths, in accordance with Kirk & Sawyer (2023) and Couchman et al. (2017).

Mineral Analysis

The mineral content was determined by Atomic Absorption Spectrophotometry after suitable digestion, following AOAC (2019) protocols.

RESULTS

Vitamin content of *Bryophyllum pinnatum*

Vitamin C was present in the highest concentration, followed by vitamin K. The lowest vitamin content was observed with vitamin B3.

Table 1: Vitamins Results.

S/N	Parameters	Concentration
1	Vitamin A (mg/g)	6.116
2	Vitamin B1 (mg/g)	0.471
3	Vitamin B2 (mg/g)	0.374
4	Vitamin B3 (mg/g)	0.038
5	Vitamin B5 (mg/g)	0.806
6	Vitamin B6 (mg/g)	0.378
7	Vitamin B7 (mg/g)	3.653
8	Vitamin B9 (mg/g)	6.255
9	Vitamin B12 (mg/g)	0.354
10	Vitamin C (mg/100)	195.741
11	Vitamin D (mg/100)	67.20
12	Vitamin E (mg/g)	5.892
13	Vitamin K (mg/100)	132

Invitro Antioxidant Analysis of *Bryophyllum pinnatum*

Antioxidant analysis (Table 2) confirmed that *Bryophyllum pinnatum* leaves exhibit notable antioxidant activity, which is beneficial in neutralizing free radicals.

Table 2: Anti-Oxidant Results.

S/N	Parameters	Concentration
1	Catalase (umol/ml)	0.186
2	Glutahione ($umol^{-1}$)	0.663
3	Superoxidase dismutase (g/ml)	0.715
4	DPPH (%)	87.797
5	Peroxidase (umol/ml)	0.576
6	FRAP (mg/g)	67.125

Mineral composition of *Bryophyllum pinnatum*

The major macronutrients identified were sodium (5.609 mg/L), potassium (3.445 mg/L), and calcium (2.093 mg/L), while magnesium (1.215 mg/L), zinc (1.594 mg/L), and iron (0.896 mg/L) were also present. Trace elements included cadmium (0.059 mg/kg), copper (0.04 mg/kg), and cobalt (0.07 mg/kg).

Table 3: Mineral Results.

S/N	Parameters	Concentration (mg/L)
1	Potassium	3.445
2	Calcium	2.093
3	Magnesium	1.215
4	Iron	0.896
5	Zinc	1.594
6	Sodium	5.609

DISCUSSION

This study examined the vitamin composition, antioxidant activity, and mineral profile of *Bryophyllum pinnatum* and highlighting its significant nutritional and pharmacological importance based on measured biochemical parameters. The vitamin composition revealed that *Bryophyllum pinnatum* contains significant amounts of essential vitamins, including vitamin A (6.116 ± 0.66 mg/g), vitamin B1 (0.471 ± 0.01 mg/g), vitamin B2 (0.374 ± 0.00 mg/g), vitamin B3 (0.038 ± 0.08 mg/g), vitamin B5 (0.806 ± 0.00 mg/g), vitamin B6 (0.378 ± 0.00 mg/g), vitamin B7 (3.653 ± 0.08 mg/g), vitamin B9 (6.255 ± 0.08 mg/g), and vitamin B12 (0.354 ± 0.00 mg/g), alongside antioxidant vitamins such as vitamin C (195.74 ± 62.22 mg/100 g), vitamin D (67.20 ± 0.33 mg/100 g), vitamin E (5.892 ± 0.08 mg/g) and vitamin K (132 ± 0.08 mg/100 g). Vitamin C exhibited the highest concentration (195.74 ± 62.22 mg/100 g), followed by vitamin K (132 ± 0.08 mg/100 g), while vitamin B3 presented the lowest value (0.038 ± 0.08 mg/g). The findings align with those of Adewale et al. (2020), who recorded vitamin C concentrations between 120–180 mg/100 g in medicinal plant extracts, which are marginally lower than the 195.74 ± 62.22 mg/100 g noted in the current study, suggesting a comparatively elevated antioxidant vitamin content. Kumar et al. (2021) documented vitamin E concentrations of 2.5–4.8 mg/g in plant extracts, which are inferior to the 5.892 ± 0.08 mg/g recorded in our study, indicating superior membrane-protective capabilities. Conversely, Gopalakrishnan et al. (2019) documented a vitamin C concentration of around 51–220 mg/100 g in Moringa oleifera, aligning with the current findings and so substantiating that *Bryophyllum pinnatum* possesses a similar abundance of antioxidant vitamins. The in vitro antioxidant assessment corroborated the robust antioxidative potential of the plant, evidenced by catalase (0.186 µmol/ml), glutathione (0.663 µmol^{-1}), superoxide dismutase (0.715 g/ml), peroxidase (0.576 µmol/ml), DPPH scavenging activity (87.797%), and FRAP (67.125 mg/g). The high DPPH value (87.797%) indicates strong radical scavenging activity. This result surpasses that documented by Omoregie and Osagie (2019), who noted DPPH activity of 65–75% in Vernonia amygdalina, indicating enhanced antioxidant efficacy in the current investigation. Akinmoladun et al. (2022) observed FRAP values of 40–55 mg/g in *Ocimum gratissimum*, which are inferior to the 67.125 mg/g recorded in this investigation, hence reinforcing the robust reducing power of *Bryophyllum pinnatum*. The levels of enzymatic antioxidants, specifically superoxide dismutase (0.715 g/ml) and glutathione (0.663 µmol^{-1}), align with the findings of Sanchez et al. (2020), who documented comparable antioxidant enzyme activities in medicinal plants, generally within the range of 0.5–0.7 µmol/ml. This indicates that *Bryophyllum pinnatum* has an effective enzymatic defence mechanism that can alleviate oxidative stress. The mineral composition analysis revealed that *Bryophyllum pinnatum* comprises vital macro- and micro-elements, with sodium (5.609 mg/L), potassium (3.445 mg/L), and calcium (2.093 mg/L) being the most prevalent. Additional minerals comprise magnesium (1.215 mg/L), zinc (1.594 mg/L), and iron (0.896 mg/L), whilst trace elements including cadmium (0.059 mg/kg), copper (0.04 mg/kg), and cobalt (0.07 mg/kg) were detected at minimal concentrations. Comparatively, Umar et al. (2018) reported potassium levels of 2.8–3.2 mg/L and calcium levels of 1.5–2.0 mg/L in leafy vegetables, which are slightly lower than the 3.445 mg/L and 2.093 mg/L recorded in this study, indicating a richer mineral composition. The iron concentration (0.896 mg/L) aligns with the levels documented by the World Health Organization (2020), which said that plant-derived iron sources often vary from 0.5–1.5 mg/L, thereby affirming its significance in haemoglobin production and the prevention of anaemia. The minimal concentrations of heavy metals detected correspond with the results of Adebayo et al. (2021), who indicated cadmium levels under 0.1 mg/kg in safe medicinal plants, so reinforcing the safety profile of *Bryophyllum pinnatum* and the study of Iboyi and Jibrin, 2016 agrees with the value of zinc and Fe is high in the three vegetables (*Vernonia amygdalina*, *Spinacia oleracea* and *Moringa oleifera*) when compared with this study. This study indicates that *Bryophyllum pinnatum* exhibits equal or superior concentrations of vitamins, antioxidants, and minerals compared to previously examined medicinal plants. The elevated vitamin C (195.74 ± 62.22 mg/100 g), DPPH activity (87.797%), and FRAP (67.125 mg/g) emphasise its significant antioxidant capacity, whereas the notable concentrations of potassium (3.445 mg/L) and iron (0.896 mg/L) accentuate its nutritional value. These findings endorse its prospective use as a functional food and therapeutic agent in the management of oxidative stress-related diseases.

CONCLUSION

Overall, the findings of this study demonstrate that *Bryophyllum pinnatum* possesses high nutritional and antioxidant value. The elevated vitamin C and DPPH activity underscore its strong antioxidant potential, while the presence of essential minerals such as potassium and iron highlight its nutritional significance. These results compare favourably with other medicinal plants and support the potential use of *Bryophyllum pinnatum* as a functional food and therapeutic agent in the management of oxidative stress-related diseases.

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