



Therapeutic Potential of *Bryophyllum Pinnatum* (*Kalanchoe Pinnata*) Leaf Juice in the Management of Kidney Stones: A Natural Remedy for Urolithiasis

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Abstract:

This study investigates the therapeutic potential of *Bryophyllum pinnatum* (*Kalanchoe pinnata*) leaf juice in the management of kidney stones (urolithiasis). Phytochemical evaluation identified bioactive compounds such as alkaloids, flavonoids, saponins, phenolic compounds, and carbohydrates, contributing to its antioxidant, anti-inflammatory, and diuretic properties. The juice demonstrated high antioxidant activity, comparable to ascorbic acid, and effectively inhibited calcium oxalate crystal formation, supporting its use in kidney stone management. Microbial load analysis confirmed its safety, while its organoleptic properties were acceptable. These findings suggest *Bryophyllum pinnatum* leaf juice as a promising natural remedy for kidney stones, warranting further clinical studies for validation.

Keywords: *Bryophyllum pinnatum*, kidney stones, antioxidant activity, phytochemical evaluation, urolithiasis

Introduction

Bryophyllum pinnatum, commonly known as "patharchatta" in India, is a renowned medicinal plant widely cultivated for its therapeutic applications. This plant, belonging to the Crassulaceae family, is scientifically recognized as *Bryophyllum pinnatum* (*Kalanchoe pinnata*). It is popularly referred to by several names, including "miracle leaf," "air plant," "cathedral bells," and "wonder of the world," alluding to its versatile healing properties. Characterized by its dark green, thick leaves and pendulous, bell-shaped blooms, *Bryophyllum pinnatum* has a unique morphology that adds to its identity as a valuable herbal remedy¹.

Traditionally, *Bryophyllum pinnatum* has been used in folklore medicine to treat a wide range of ailments. Its juice, extracted from fresh leaves, has shown significant therapeutic potential, particularly in the management of kidney stones (urolithiasis). Kidney stones, a prevalent urological condition caused by the accumulation of mineral and crystalline deposits in the urinary tract, are often associated with severe pain, inflammation, and urinary obstruction.

Conventional treatments, including medications and surgical interventions, can be effective but often come with side effects and high costs. This has driven interest in natural remedies like *Bryophyllum pinnatum*, which offer a safer and cost-effective alternative.

The leaves of *Bryophyllum pinnatum* are known to possess diuretic, anti-crystallization, and anti-inflammatory properties that make them ideal for treating kidney stones. The juice not only aids in increasing urine production, facilitating the flushing out of small stones, but also inhibits the aggregation of calcium oxalate crystals, which are the primary constituents of most stones. Furthermore, its antioxidant properties help reduce oxidative stress and inflammation in the urinary tract, alleviating pain and preventing complications^{1,2}.

Beyond its use in kidney stone management, *Bryophyllum pinnatum* has been found to exhibit a broad spectrum of pharmacological activities, including anti-inflammatory, antimicrobial, and antioxidant effects. This makes it a valuable resource in herbal medicine for addressing various health conditions. However, despite its widespread traditional use, there is a need for scientific validation to standardize its usage and establish its safety and efficacy through rigorous research.

Objectives of the Study

1. To perform a comprehensive phytochemical evaluation of *Bryophyllum pinnatum* leaf juice to identify and quantify active constituents such as flavonoids, alkaloids, saponins, and phenolic compounds.
2. To formulate a stable and effective herbal preparation using *Bryophyllum pinnatum* leaf juice with appropriate preservatives and excipients to enhance shelf life and usability.
3. To evaluate the formulated herbal product for its physicochemical properties, stability, and therapeutic efficacy in the management of kidney stones.
4. To assess the diuretic, anti-crystallization, and antioxidant activities of the formulation through in-vitro and in-vivo studies to validate its potential for urolithiasis treatment.

Anatomical Study of *Bryophyllum pinnatum* Leaves

The anatomical characteristics of *Bryophyllum pinnatum* leaves provide insights into its physiological and pharmacological properties. The study involves the microscopic examination of structural features such as stomata, vein islets, and other cellular components that contribute to the plant's medicinal potential^{3,4}.

- **Vein Islets and Terminations:**

Vein islets (10–15/mm²) and terminations (4–6/mm²) support efficient vascular transport for growth and metabolism.

- **Stomatal Analysis:**

Stomatal number: upper surface (7–10/mm²), lower surface (10–12/mm²); stomatal index: 8–10%. Higher stomata on the lower surface aid gas exchange and water regulation.

- **Leaf Structure:**

Thick, fleshy leaves store water; dark green color indicates high chlorophyll for photosynthesis.

- **Specialized Features:**

Hydathodes enable guttation; waxy epidermal cells prevent water loss and microbial damage.

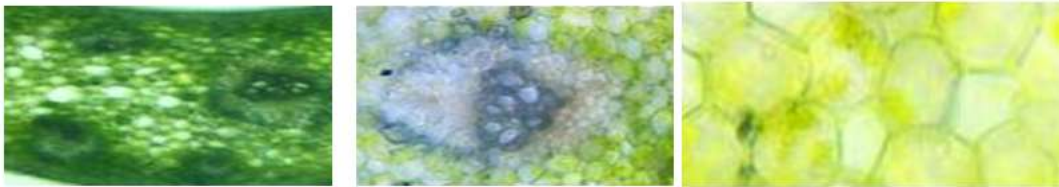


Figure 1: Anatomical Study of Bryophyllum pinnatum Leaves

Preparation of the Juice of *Bryophyllum pinnatum*

Fresh *Bryophyllum pinnatum* leaves (500 g) were collected, cleaned thoroughly, and crushed. The crushed leaves were ground with a grinder for 30 minutes, and a 4:8 ratio of distilled water was added to dilute the extract. The resulting juice was filtered twice using sterilized filters for clarity and microbial safety. To ensure preservation and shelf life, 0.1% sodium benzoate and 0.2% citric acid were added as preservatives. The prepared juice was stored in sterilized containers under refrigeration to maintain its quality and efficacy^{5,6}.

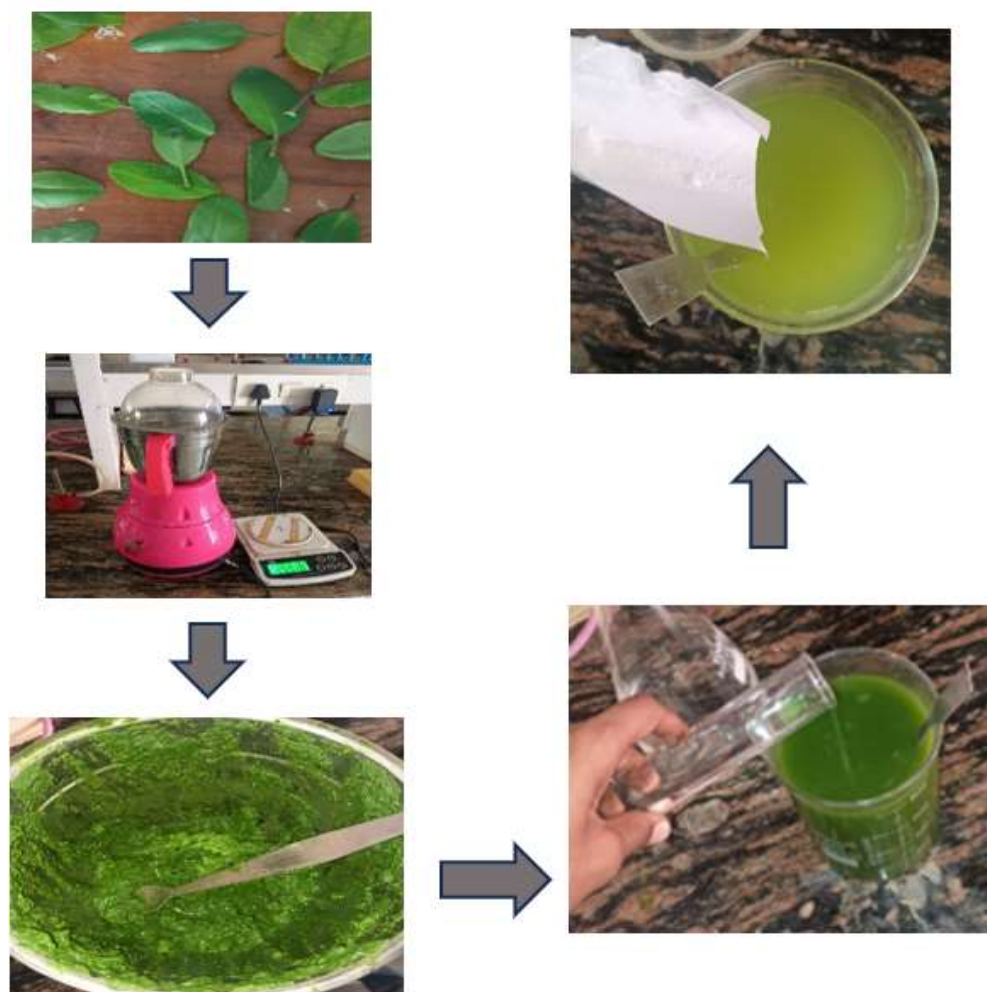


Figure 2: Preparation of the Juice of *Bryophyllum pinnatum*

Evaluation of *Bryophyllum pinnatum* Juice

The juice of *Bryophyllum pinnatum* was evaluated for its physicochemical, phytochemical, and biological properties. Physicochemical parameters such as pH, stability, and preservative effectiveness were tested to ensure quality and shelf life. Phytochemical screening identified bioactive compounds like alkaloids, flavonoids, saponins, phenolic compounds, and carbohydrates. Antioxidant activity was assessed through free radical scavenging tests, while anti-crystallization studies confirmed its potential to inhibit calcium oxalate aggregation. Microbial load analysis ensured safety, and organoleptic properties, including taste, odor, and appearance, were evaluated for acceptability.

Phytochemical Evaluation of *Bryophyllum pinnatum*

Phytochemical evaluation of *Bryophyllum pinnatum* juice was performed to identify and confirm the presence of bioactive compounds like alkaloids, flavonoids, saponins, phenolic compounds, carbohydrates contributing to its therapeutic properties ⁷.

Antioxidant Activity Evaluation

To evaluate the antioxidant activity of *Bryophyllum pinnatum* juice, the DPPH (2,2-diphenyl-1-picrylhydrazyl) free radical scavenging assay was used. Fresh leaves were collected, washed, and crushed to extract juice, which was then diluted into varying concentrations. A 0.1 mM DPPH solution was prepared in methanol, and ascorbic acid was used as the standard antioxidant. For each test, 2 mL of the DPPH solution was mixed with 1 mL of the juice sample and incubated in the dark for 30 minutes at room temperature. Absorbance was measured at 517 nm using a UV-Vis spectrophotometer, and a blank sample was used for baseline correction. The scavenging activity percentage was calculated using the formula⁸ :

$$\text{Scavenging Activity Percentage} = \frac{\text{Absorbance of Control} - \text{Absorbance of Sample}}{\text{Absorbance of Control}} \times 100$$

Results

The juice demonstrated a stable pH (5.8–6.2) with no physical changes over storage, indicating good stability. Phytochemical tests confirmed the presence of key bioactive compounds, was observed.

S. No.	Phytochemical	Test Performed	Result	Significance
1	Alkaloids	Mayer's Reagent, Dragendorff's Test	Positive	Analgesic and anti-inflammatory effects
2	Flavonoids	Lead Acetate, Shinoda, NaOH Test	Positive	Antioxidant and anti-crystallization properties
3	Saponins	Foam Test	Positive	Diuretic activity and urinary tract health
4	Phenolic Compounds	Ferric Chloride Test	Positive	Strong antioxidant activity
5	Carbohydrates	Benedict's, Fehling's, Molisch Test	Positive	Supports energy metabolism

Antioxidant Activity Evaluation

The *Bryophyllum pinnatum* juice exhibited high antioxidant activity, with a concentration-dependent increase in free radical scavenging ability. At higher concentrations, its activity was comparable to the standard ascorbic acid. The IC₅₀ value, representing the concentration required to neutralize 50% of DPPH radicals, was found to be within an effective range, demonstrating the juice's strong antioxidant potential. This activity is attributed to the presence of bioactive compounds such as flavonoids and phenolic compounds, which reduce oxidative stress and support the plant's therapeutic applications in kidney stone management.

Conclusion

Bryophyllum pinnatum leaf juice demonstrates promising therapeutic potential in the management of kidney stones (urolithiasis). The phytochemical evaluation revealed the presence of bioactive compounds such as alkaloids, flavonoids, saponins, phenolic compounds, and carbohydrates, which contribute to its antioxidant, anti-inflammatory, and diuretic properties. The juice exhibited significant antioxidant activity, comparable to ascorbic acid, supporting its role in reducing oxidative stress associated with kidney stones. Additionally, its ability to inhibit calcium oxalate crystal formation further underscores its efficacy in preventing and managing kidney stones. The juice's microbial load analysis confirmed its safety for consumption, while its organoleptic properties taste, odor, and appearance were found acceptable, enhancing its potential for patient compliance. These findings suggest that Bryophyllum pinnatum leaf juice is a viable natural remedy for kidney stones, offering a cost-effective, safe alternative to conventional treatments. Further clinical studies and standardized formulations are necessary to fully establish its efficacy and therapeutic applications.

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