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Review Article

Phytochemical and Pharmacological Review of *Ensete Superbum (*Roxb.) *Cheesman Fruits* and Seeds: An Emerging Medicinal Treasure

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ABSTRACT

Ensete superbum (Roxb.) Cheesman, commonly known as Cliff Banana, is a monocarpic perennial shrub from the Musaceae family, native to the Western Ghats, northeastern India, and northern Thailand. The plant grows up to 3.7 meters tall with a swollen base and produces small, triangular fruits containing brown seeds. The seeds of Ensete superbum are valued for their medicinal properties and have been traditionally used by indigenous healers to treat conditions like stomach-ache, diabetes, measles, leucorrhoea, debility, and kidney stones. The seeds are rich in various phytochemicals, including alkaloids, flavonoids, saponins, tannins, and phenols. Phytochemical and pharmacological studies suggest the plant has significant antioxidant, anti-inflammatory, antimicrobial, antidiabetic, analgesic, anti-fertility, nephroprotective, and anti-urolithiatic activities. The plant thrives in damp, rocky terrains and is particularly noted for its adaptability to dry conditions. Additionally, its ethnobotanical uses include treating snake bites, jaundice, psychomotic disorders, and promoting easy delivery in pregnant women. Despite its widespread traditional use, further research is needed to isolate and study the chemical constituents of its seeds and roots for potential clinical applications. The current study emphasizes the need for more comprehensive research to explore the medicinal potential of Ensete superbum for human health.

INTRODUCTION

Ensete superbum (Roxb.) Cheesman, commonly known as Cliff Banana, is a member of the family Musaceae family of the order Zingiberales [1]. The genus word "Ensete" was first coined by Horaninow in 1862 and in 1947 twenty-five species of Ensete were added by Cheesman [2]. It is native to the Western Ghats, the Northeastern hills of India, and Northern Thailand [1]. The vernacular names for ensete super bum includes: "Kalluvazha", "Malavazha", "Junglikela", "Bahuja", "Katu-vala" [3]. This plant is a

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monocarpic, non-stoloniferous perennial shrub that does not produce suckers like other members of the banana family [4]. This genus which consists of nine species of Ensete are: *Ensete superbum* (Roxb.) Cheesman (Indian), *Ensete glaucum* (Indian), *Ensete ventricosum* (South-west Ethiopia), *Ensete gilletii*, *Ensete homblei*, *Ensete perrieri*, *Ensete wilsonii*, *Ensete edule* and *Ensete sp*, "Thailand" [5]. The plant may grow up to 3.7 meters (12 feet) tall, with the pseudo stem reaching up to half the height and a swollen base that can be up to 2.5 meters (8 feet) in circumference. The leaves are bright green on both sides, featuring a deeply grooved, short petiole. The leaf sheaths persist at the base, leaving closely set scars on the corm. The fruits are slightly less than 8 cm (3 inches) long, roughly triangular, and contains dark brown seed. During the dry season, the upper parts of the plant dry off, leaving only the corm, which produces new leaves at the start of monsoon. Instead, seeds are the only mode of natural multiplication.[6] The seeds of *Ensete superbum* are valued for their medicinal properties and are used by indigenous healers as a remedy for various conditions such as stomach ache [7], diabetes [8], measles [9], leucorrhoea [10], debility [11] and kidney stone[12]. The seed are 8-12mm in diameter and brownish – black in colour. They are sub globose in shape but angled due to pressure. The seed coat is hard and consist of exotesta and mesotesta, which are made up of schlerenchyma cells [13]. A silica layer in the seed coat further strengthens and hardens it. Additionally, the seeds contain a perisperm, endosperm, embryo and chalazal disc [14]. There are different types of phytochemicals present in it. They are Alkaloids, Flavonoids, Saponins, Tannins, phenols, Anthraquinone glycosides, Steroids, amino acids, Triterpenoids and Carbohydrates [15].

Geographical Distribution

Ensete superbum is renowned for its exceptional flexibility and endurance in its environment during dry periods. It flourishes on damp, moss-covered rock margins, rock gaps, and barren rocky terrains, especially in the Western Ghats, northeastern sub-Himalayan areas, and the arid deciduous woodlands of central and Western India. The plant's therapeutic qualities, along with its robust, rain-dependent, and ever-present nature, make it an ideal crop for enhanced use of Class 7 type land in India [16].

Plant Profile [17]

Systematic Classification:

- Kingdom: Plantae
- Division: Angiospermae
- Class: Monocotyledonae
- Sub-class: Commelinids
- Order: Zingiberales
- Family: Musaceae
- Genus: *Ensete*
- Species: *superbum*
- Common Name: Indian Wild Banana, Hill Banana
- Bot. Name: *Ensete superbum*



Figure 1- *Ensete superbum* (Roxb) Cheesman

Morphological Characteristics Seed



Figure 2 – Seeds of *Ensete superbum*

Morphological Characters of *Ensete superbum* Seeds

- Shape and Size: The seeds of *Ensete superbum* are small, rounded to oval or irregularly triangular, with an approximate diameter of 3-5 mm. Some seeds may appear slightly compressed.
- Colour: Mature seeds exhibit a dark brown to blackish colour with a glossy or shiny appearance.
- Surface Texture: The seed surface is hard, rough, and slightly wrinkled, often displaying reticulate (net-like) patterns.
- Weight: The seeds are lightweight due to their small size.
- Odor and Taste: The seeds are odourless and have a bitter taste.
- Hilum: A small, circular hilum mark is present on one side of the seed.
- Testa (Seed Coat): The seed coat is thick, hard, and protective, made up of sclerenchyma cells.
- Endosperm: The seed contains a dense, hard endosperm with parenchyma cells, starch grains, and calcium oxalate crystals.
- Embryo: The small embryo is located near the hilum region, as seen in other Musaceae members.

Macroscopy

The seeds are dark brown, sub-globose but angled due to pressure, measuring 0.8 cm in length, 1 cm in breadth, and 0.8-1.3 cm in diameter. A longitudinal cut through the seed reveals a micropyle and an embryo embedded in endosperm, which appears as a white coloured powder. The lower end contains a cavity known as the chalazal mass.

Microscopy

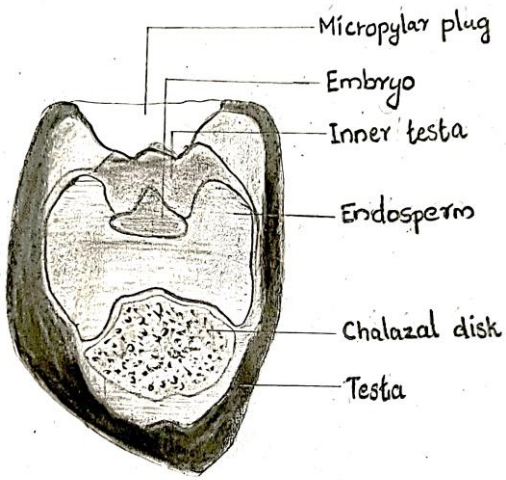


Figure 3 – A Longitudinal View Of *Ensete Superbum* Seed.

The macerated testa of the seed shows compactly arranged polygonal cells, with wax drops settled on the surface due to maceration. These cells measure approximately 60×40 µg. The inner epidermis of the seed contains, elongated, closely arranged cells with longitudinal striations, measuring about 196×25µg. The inner region of the seed coat consists of thin to thick walled, then sclereids of porous type, which are elongated to round and have narrow lumens. The crushed embryo contains thin-walled parenchyma with aleurone grains, oil drops and starch. The cells in this region measure about 46 µm in diameter. The powdery endosperm consists of numerous parenchyma cells measuring 118 ×62 µm, prismatic crystals of calcium oxalate measuring 54×44 µm, and abundant starch grains measuring 5µm in diameter. *Ensete superbum* is a largely untapped medicinal plant with significant potential. Indigenous communities in various regions of India utilize its seeds to prepare

medicines that are believed to treat a wide range of human ailments without causing any harmful side effects [18]. The current study has revealed detailed pharmacognostic characters of this medicinal banana seed, which is commonly found growing in the crevices of rocks. The seeds of E. superbum consist of several parts: a tough seed coat, perisperm, endosperm, embryo, and chalazal disk. The seed coat is made up of an outer layer (exotesta) and an inner layer (mesotesta), both composed of sclerenchyma cells. The hardness of the seed coat plays a crucial role in protecting the seed throughout its development, dispersal, and dormancy [19] . Moreover, a layer of silica is present in the seed coat strengthens its structure and safeguards the embryo and endosperm from physical damage [20] . The inner part of the seed coat contains sclereid cells with narrow lumens, contributing to the rigidity and toughness of the coat [21]. Ethnobotanical and Ayurvedic reports indicate that *Ensete superbum* is commonly used in folk medicine across the country to treat various ailments. The ointment made from its leaves mixed with butter is reported to treat leukoderma. Additionally, decoctions of its seeds and stems are used to treat victims of dog bites, while root decoction is employed by the tribals of the North Maharashtra region to treat veneral diseases [22]. The entire plant is also used in the treatment of jaundice [23]. Furthermore, ethnomedical reports mention that seed powder of *Ensete superbum* is used for treating psychomotic disorders [24]. Some studies report the application of fresh root juice to assist with easy delivery in pregnant women, as well as the use of powdered seeds with cow milk to enhance semen production [25]. A paste made from the peduncle and honey is administered to eliminate kidney stones [26]. In total, 38 ethnomedicinal uses of the entire plant for treating various ailments have been documented by tribals across different states [27]. For instance, the pith of the plant is taken orally in its raw form to cure appendicitis [28].

Ethnobotanical investigations also reveal that tribals from the Satpura Range forests of North Maharashtra frequently use seed paste from E. superbum to treat snake bite victims. Additionally, several pharmacological studies have been conducted on E. superbum to explore its effectiveness in treating various disorders and other health conditions [29].

Fruit

Ensete superbum is a herb type banana species which is monocarpic in nature. The plant can grow up to 4 meters tall, featuring a substantial base and a pseudo-stem formed by layers of overlapping leaf sheaths. Its leaves are tapering at the base, oblong in nature, having short petioles with deep grooves and which are bright green in colour. The plant's inflorescence starts as a spherical shape before transforming into a curved terminal spike on a sturdy peduncle. The braces are large, orbicular, and dark brown to red in colour, measuring around 1 meter in length and width, arranged in dense rows of 11 to 15 flowers. The outer perianth is white -coloured one, while the outer is larger than the inner. The fruit is an oblong berry measuring 7.5 to 8.0 cm long, which containing triangular brown or black seeds. This species reproduces solely by seed, as it does not produce suckers or stolons. It dies back during the winter and regrows from the corm in the spring [30]. During the dry season, the plant dies back to an underground corm and produces new leaves with the arrival of the monsoons. The fruit is an sub coriaceous type, which is of 7.5 cm in length and3.5 cm in diameter, with a thick skin and a triangular shape in cross-section. Inside, it contains numerous dark brown seeds thar are brownish- black, sub globose, but angled due to pressure, and range from 8 to 12 mm in diameter [31].

Pharmacognostical Identification

Parameter	Description
Shape	Oval, Triangular
Colour	Dark Brown to Black
Texture	Hard, Wrinkled
Odor	Odorless
Taste	Bitter
Size	3-5 mm
Surface	Reticulate

Phytochemical Analysis

- Various chemical constituents from different chemical classes have been reported from *Ensete superbum* till date including:
- Alkaloids, Saponins, Tannins, Phenols, Flavonoids, Anthraquinone glycoside, Steroids , Amino acids , Triterpenoids, Carbohydrates.

Table 1 – Constituents present in Ensete superbum [56]

Constituents	Leaf	Fruit	Root	Seed	Rhizome	Pseudostem
Alkaloids	+	+	+	+	+	+
Carbohydrates	+	+	+	+	+	+
Steroids	±	+	+	+	+	+
Saponins	+	+	+	+	+	+
Amino Acids	+	+	+	+	+	+
Phenols	+	+	+	+	+	+

(+) present, (±) partial presence

Pharmacological Properties

1. Antioxidant properties

Like many plants in the Musaceae family, *Ensete superbum* has been reported to possess antioxidant activity. This may be due to the presence of flavonoids, phenolic compounds, and other secondary metabolites that can neutralize free radicals, potentially reducing oxidative stress and damage to cells The antioxidant qualities of *Ensete superbum*, also referred to as the wild banana, have been the focus of numerous investigations. Phenolic compounds, flavonoids, and other phytochemicals that contribute to the plant's antioxidant action have been found in substantial amounts in the pseudostem, seeds, flowers, and bracts, among other portions of the plant. It is noteworthy that thermal processing has been demonstrated to improve these antioxidant qualities, possibly because of the cell wall's bound phenolics being released.

The bract's potential as a useful source of natural antioxidants is further shown by the fact that its aqueous extract has shown significant antioxidant activity in a few tests. Based on these findings, *E. superbum* may be a promising functional food component with positive health effects[33].

2. Anti-inflammatory Effects

The plant may exhibit anti-inflammatory properties, which could be beneficial in the treatment of conditions characterized by inflammation, such as arthritis or other inflammatory disorder. This is commonly attributed to its bioactive compounds, such as polyphenols and flavonoids. Studies conducted both *in vitro* and *in vivo* have shown that *Ensete superbum*, also referred to as the wild banana, has strong anti-inflammatory qualities. Studies reveal that plant extracts from different components, especially the peel, have strong anti-inflammatory properties. One study, for example, showed significant in vitro anti-inflammatory effects using a peel dioxane fraction from mature. Furthermore, by modifying oxidative stress and inflammatory parameters, *in vivo* research has demonstrated that adding *E. superbum* peel extract to functional food products like cold-pressed orange juice effectively reduces ulcerative colitis in rat models. These results highlight *E. superbum's* therapeutic

potential as a natural anti-inflammatory drug, indicating the need for more investigation into its possible uses in the treatment of inflammatory disorders [34].

3. Antimicrobial Activity

Some studies have suggested that extracts from *Ensete superbum* might possess antimicrobial properties. The plant could be effective against certain bacterial and fungal pathogens, making it useful for treating infections or promoting overall health. The wild banana, or *Ensete superbum*, has shown strong antibacterial qualities, especially against viral infections. Research has demonstrated that specific fractions extracted from the seeds exhibit antiviral properties against the vaccinia and variola viruses. Furthermore, studies on allied *Ensete species*, such E. gilletii, have shown that root extracts have antibacterial activity, indicating that other Ensete species might likewise have antimicrobial qualities. These results demonstrate *Ensete superbum's* potential as a source of bioactive chemicals with antibacterial properties, indicating the need for additional study to completely clarify its potential medicinal uses [35].

4. Antidiabetic Activity

Although there is no extensive clinical research, some related species in the Musaceae family are known to have antidiabetic effects, potential due to the ability to regulate blood sugar levels and improve insulin sensitivity. *Ensete super bum* may share similar actions, though further research is needed. Preclinical research has shown that *Ensete superbum*, also referred to as the wild banana, has strong antidiabetic potential. According to research, *E. superbum* ethyl acetate fractions had strong inhibitory effects on enzymes that break down carbohydrates, including α-amylase and α-glucosidase. *In vivo* experiments have demonstrated that the injection of these fractions results in notable decreases in blood glucose levels, improvements in lipid profiles, and increases in serum insulin levels in rats given a high-fat diet and modest doses of streptozotocin to induce diabetes. Histopathological analyses also showed that the treated groups' pancreatic damage had improved. These results imply that *E. superbum* has potential as a natural antidiabetic drug, requiring more investigation to completely clarify its therapeutic potential and modes of action[36].

Conventional Applications and Associated Studies

Traditional Uses: *E. superbum* has long been used by indigenous groups for its therapeutic benefits, which include treating dysentery, diarrhea, and stomachaches. Anti-Inflammatory Activity: According to certain research, *E. superbum* has anti-inflammatory properties. These results point to a possible indirect analgesic effect because inflammation frequently causes pain. Although *Ensete superbum* has been used historically to treat a few illnesses and has shown anti-inflammatory qualities, there is currently no concrete scientific proof that it has analgesic effects. To assess its potential as a pain-relieving agent, more research is required.

5. Anti-fertility

The ethanolic extract of *Ensete superbum* seeds have been shown to an anti-fertility activity. The antifertility properties of *Ensete superbum* seeds, as evidenced by both traditional practices and scientific studies, highlight their potential as a natural contraceptive agent. However, comprehensive clinical trials are essential to fully understand their efficacy, safety profile, and potential applications in human health [37].

6. Nephroprotective

The hydro alcoholic extract of *Ensete super bum* seeds has been shown to have nephroprotective activity *Ensete superbum* seeds have encouraging nephroprotective properties, especially in diabetic circumstances. Their potential therapeutic benefit is highlighted by their capacity to alleviate

histopathological alterations, boost antioxidant defences, and improve renal function markers. However, more investigation, including clinical trials, is required to completely clarify their safety and effectiveness in people [38].

7. Anti-Urolithiatic

The seed extract of *Ensete superbum* has been shown to inhibit the growth of CHPD (calcium hydrogen phosphate dihydrate) crystals. Calcium Oxalate Inhibition: Prevents calcium oxalate crystallisation and aggregation. Anti-Inflammatory Action: Reduces inflammation caused by stone formation. pH Modulation: Helps to maintain urine pH, which prevents stone development [39].

8. Analgesic Effects

Traditionally, plants in the Musaceae family are sometimes used for pain relief. Some components of *Ensete superbum* may exhibit mild analgesic (pain relieving) effects. The wild banana, *Ensete superbum*, has long been used in traditional medicine to cure conditions like dysentery, diarrhea, and stomachaches. Its analgesic (pain-relieving) qualities, however, are not well supported by scientific research[40].

Futurem Prospects

Future study should focus on isolating and characterizing active phytochemicals.

• Molecular processes behind anti-urolithiatic activity.

• Clinical trials to determine safety and efficacy.

• Developing formulations for therapeutic uses.

CONCLUSION

Ensete superbum is an important plant with a variety of ingredients, used in crude dosage forms in folk medicine by tribals since ancient times. Its main pharmacological properties include anti urolithiatic, nephroprotective, anti-fertility and anti-viral activities. However, research on this plant is still insufficient, and many aspects remain unexplored, such as the different chemical constituents of it's seeds and root portions, as well as their isolation. This area requires separate attention. Futher studies should be conducted to explore these hidden aspects and their potential clinical applications for the welfare of human beings.

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