

# Pharmacological Properties of Banana Stem: An Updated Review

Samrudhi S. Kendole, K.M. Lakshmi Priya, Rajadurai Murugan\* and T.V. Eshanya

Food Science and Technology, Department of Food Technology, Faculty of Life and Allied Health Sciences, Ramaiah University of Applied Sciences, Bangalore, 560054, Karnataka, India

**Abstract:** *Musaceae* is a perennial tree-like plant that is cultivated all over the world in various tropical and subtropical regions. The fruit, peel, leaves, pseudo-stem, stalk, and inflorescence (flower) of this plant, among other parts, are utilized in traditional medicine to treat several health problems. The banana stem juice has potential biological effects, including anti-diabetic, anti-inflammatory, anti-microbial, anti-helminthic, wound-healing, anti-cancer, anti-oxidant, and anti-urolithic activities. Consequently, it can be said that banana stem juice contains adequate levels of healthy secondary metabolites that are essential for maintaining good health. To find novel approaches for treating and preventing a wide range of medical diseases, more studies into the medicinal potential of banana stem juice can be done. Hence, this review emphasizes *Musaceae* stem juice's medicinal and nutritional benefits as review.

**Keywords:** *Musaceae*, banana pseudo stem juice, pharmacological properties, folk medicines, nutritional value, phytochemicals, anti-urolithiasis property.

## INTRODUCTION

In recent years, there has been a significant amount of attention to the utilization of medicinal plants as a crucial part of preserving health and curing disease. It is becoming more and more common because using medicinal plants as a form of treatment often has fewer side effects than using pharmaceutical drugs. The World Health Organization (WHO) reports that a major segment of the population in developing nations uses traditional medicine for basic health care. As a result, the demand for medicinal plants is increasing in both emerging and industrialized countries [1]. The banana is a well-known tropical fruit. The banana plant moved from its native southwestern Pacific location to India around 600 BC and then expanded throughout the tropical world. It is thought to be the world's oldest cultivated crop. It even expanded to the Pacific Islands and the West Coast of Africa as early as 200-300 BC [2].

Banana plants are regarded as one of the most beneficial plants in the world. Almost all parts of the plant's components, such as the fruit, peel, leaves, pseudo-stem, stalk, and inflorescence (flower), can be used. Bananas are monocotyledonous plants belonging to the genus *Musa*, family *Musaceae*, and order *Zingiberales*. Studies showed that *M. acuminata* phenolic compounds have a significant part in its diverse spectrum of pharmacological activities, including various medicinal uses. Bananas provide several health benefits. This is due to the fact that

bananas aid in the body's ability to retain calcium, nitrogen, and phosphorus, all of which are necessary to grow healthy and regeneratable tissues [1]

The two main parthenocarpic banana species are *Musa accuminata* Colla and *Musa balbisiana* Colla. *Musa accuminata* Colla has several health-promoting and disease-preventing properties ascribed to its significant bioactive compounds, which can be found in the stem, fruit, pseudo stem, leaf, flower, sap, inner trunk, root, and inner core. Phenolics, carotenoids, biogenic amines, phytosterols, and volatile oils are some of these substances. The pharmacological effects of banana stem juice include anti-oxidant, immunomodulatory, antibacterial, antiulcerogenic, hypolipidemic, hypoglycemic, leishmanicidal, anthelmintic, and anti-cancer properties [3].

## Taxonomy

- Kingdom: Plantae
- Subkingdom: Viridiplantae
- Infrakingdom: Streptophyta
- Super kingdom: Embryophyta
- Division: Tracheophyta
- Subdivision: Spermatophytina
- Class: Magnoliopsida
- Superorder: Lilianae
- Order: Zingiberales

\*Address correspondence to this author at the Department of Food Technology, Faculty of Life and Allied Health Sciences, Ramaiah University of Applied Sciences, Bangalore, 560054, Karnataka, India; E-mail: rajadurai.ft.ls@msruas.ac.in



**Figure 1:** Different parts of the banana plant (source: internet).

- Family: Musaceae
- Genus: Musa
- Species: acuminata (1)

### Traditional Uses

Traditional uses for the fruit of *M. paradisiaca* and *M. sapientum* include the treatment of diabetes, dysentery, intestinal lesions in ulcerative colitis, diarrhea, sprue, uremia, nephritis, gout, hypertension, and cardiac diseases. In dysentery and menorrhagia, flowers are used in the treatment. Diarrhea, dysentery, cholera, otalgia, and hemoptysis are all treated with juice from the fruit plant's stem, while menorrhagia, diabetes, and dysentery are treated with juice from the flower. The root is used to treat sexual infections, blood abnormalities, and anthelmintics. The herb is also employed for pain, inflammation, and snakebites [2].

### Nutritive Value

Tropical fruit with a lot of calories, bananas provide good nutrition in a number of ways. The *Musa* family plants contain sterols, phenolic acid, anthocyanins, phenolic acids, starch, and fructans. The pseudo stem of banana is relatively low in fat content (0.98%); hence fats do not add significantly to the energy content. The carbohydrate, protein, and starch content in the Banana pseudo stem is approximately (46.58%), (7.34%), and (21.06%) respectively. The total dietary fiber content of pseudo stem is (61.14%) of which the soluble dietary fiber and the insoluble dietary fiber (IDF) are approximately (02.04%), and (59.10%) respectively [4]. High dietary fiber diets are effective at producing early satiety signals by lengthening the time food remains in the stomach, lowering the risk of stomach ulcers.

While dietary fibers as a whole are, the soluble fibers have the quality of having a greater expansion volume. Insoluble fibers swell on consumption, reducing the bulk density of the dietary items, and interaction with water encourages unwanted materials to be eliminated by expanding bowel movements. Thus, a diet high in fiber promotes digestion, as well as waste removal and preventing constipation. This suggests that banana by-products may eventually substitute oats and sorghum as a fiber-rich food source [4].

The study also reveals that flavonoids are abundant and are well-known for their anti-oxidant effects. Higher levels of flavonoids and saponins were found in the pseudo stems of two *Musa spp.* Bananas, *Baxijiao* (saponins: 0.11 g/100 g), and *Paradisiacal* (saponins: 0.12 g/100 g), and given these advantages, the promise of Banana pseudo stems for their health-promoting qualities is affirmed [4]. In a study, it was observed that ascorbic acid content was high in Banana pseudo stem (8.81mg/100g) compared to other vitamins, such as vitamin E, riboflavin, thiamine, niacin, beta carotene, pyridoxine, and pantothenic acid [5].

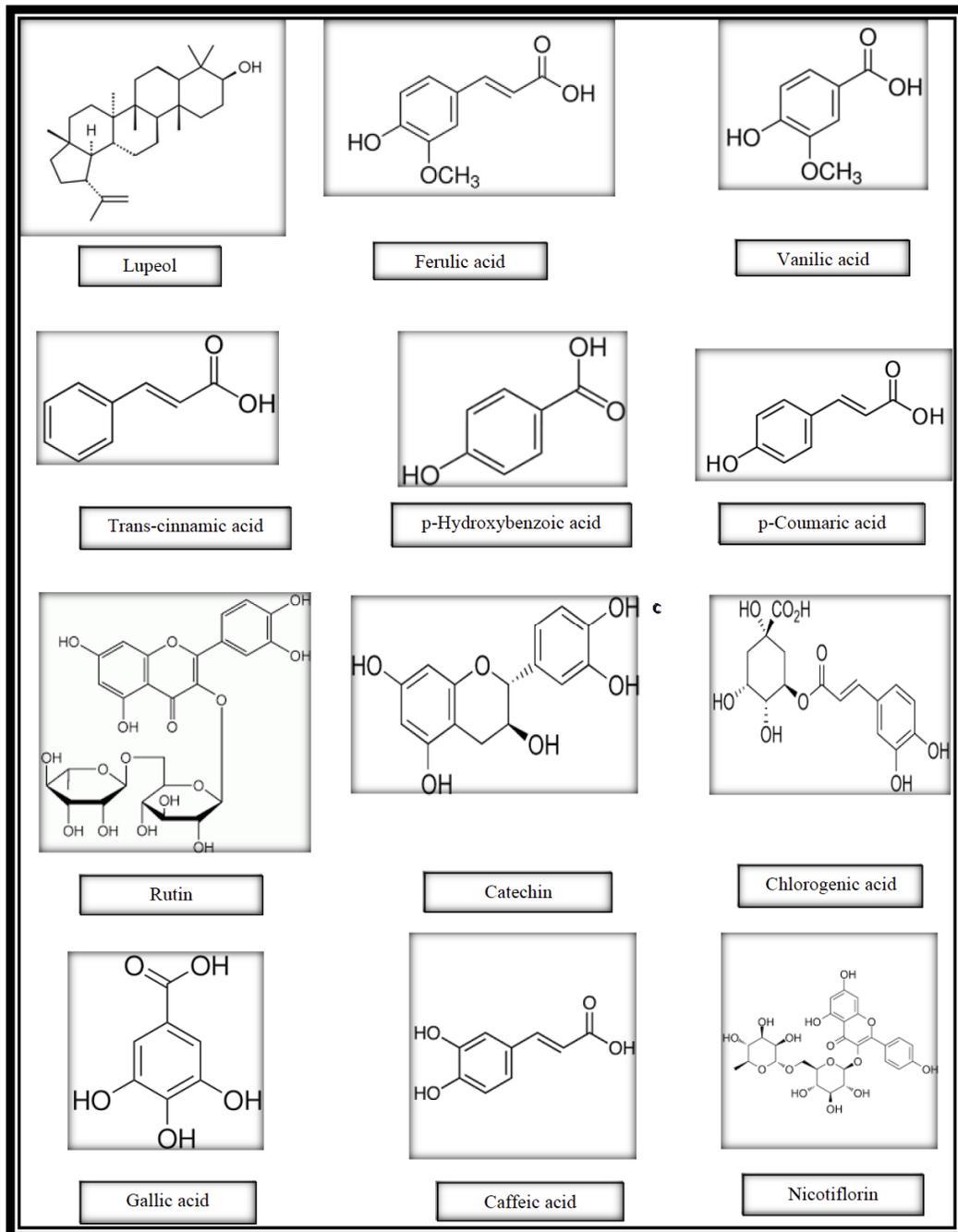
Additionally, the availability of the vitamin B complex in considerable amounts emphasizes the potential of the banana pseudo stem (by-product) for treating many disorders, including prostate cancer [4]. The mineral content in the banana stem is in the order  $K > Ca > Mg > P > Na$ . Together the microminerals of Banana pseudo stem showed the presence of Fe, Mn, Zn, Cu, Al, and several other minerals such as iron, manganese, copper, and zinc are components of numerous significant proteins and enzymes involved in the metabolism of macronutrients and bodily function. Overall, the concentrations of these minerals were

identical to those discovered in the *Baxijiao* and *Paradisiacal* varieties of *Musa spp.* [4].

### Phytochemical Profile

As plants are a major source of bioactive chemicals, it is necessary to combine ethnobotanical, phytochemical, and biological methodologies in a multidisciplinary approach to the development of novel chemical compounds. The fruit, peel, flower, leaf, pseudo stem, and rhizome have all been shown to

contain a range of phytochemicals, including saponins, terpenoids, steroids, anthocyanins, fatty acids, tannins, phenols, and alkaloids. Depending on the type of extraction process utilized, different amounts of phytochemicals can be detected [1]. Different varieties of *Musa* stem have been found to contain bioactive substances such as Lupeol, Ferulic acid, Vanillic acid, Trans-cinnamic acid, *p*-Hydroxybenzoic acid, *p*-Coumaric acid, Rutin, Catechin/Epicatechin, Chlorogenic acid, Gallic acid, Caffeic acid, Nicotiflorin [6]. The *Musa* species has also been shown to have



**Figure 2:** Phytochemicals present in various species of Banana stem.

effects, and pharmaceutical activities, including anti-inflammatory, immunostimulatory, anti-cancer, antiulcerogenic, hypolipidemic, hypoglycemic, anthelmintic, and leishmanicidal effects [7].

## Pharmacological Properties

### Anti-Diabetic Effect of Banana Stem Juice

The bioactive components in *Musa* stem extract stimulate the generation of insulin and lower blood glucose levels [8]. The anti-hyperglycemic function of the banana stem juice, which circulates the glucose utilization to build glycogen, helps to control the blood glucose level [9]. As banana stem juice contains a wide range of bioactive substances, it prevents the processes of glycogenolysis and gluconeogenesis, which helps to control blood sugar levels in the body [10]. Alkaloids, saponins, flavonoids, tannins, phlorotannins, phenolics, glycosides, terpenoids, and steroids are low-molecular-weight bioactive phytochemicals present in pseudo stem of various species of *Musa* family [4], which are responsible for the anti-diabetic effect. In many tropical nations, banana stem juice has traditionally been used as a therapeutic agent for diabetics.

### Anti-Inflammatory Effect

Previous studies on *Musa acuminata* Stem Extract (MASE) showed that it has antibacterial, antifungal, and anti-oxidant properties [11]. The most ubiquitous bioactive substance in MASE is tannin, which contains polyphenols. The availability of the polyphenol component promotes the anti-inflammatory action through the inhibitory mechanism of tumor necrosis factor  $\alpha$  (TNF- $\alpha$ ) and nuclear factor kappa  $\beta$  (NF- $\kappa$ B) signal. The TNF- $\alpha$  is a pro-inflammatory cytokine produced by activating the NF- $\kappa$ B. The anti-inflammatory activity is due to the inhibition of NF- $\kappa$ B and TNF- $\alpha$  components, and thus accelerates the wound healing process [12,13]. Therefore, this study aimed to determine if *Musa acuminata* has an anti-inflammatory effect by measuring the expression of TNF- and NF-B after 3 days of using MASE on oral mucosal lesions.

### Anti-Microbial Effect

The presence of phenolic chemicals, flavonoids, terpenoids, alkaloids, proteins, tannins, saponins, and cardiac glycosides was discovered during the preliminary phytochemical screening of extracts of the Banana pseudo stem, which are responsible for the

antibacterial activity. The phytochemical constituents were: Alkaloid (8.16%), Flavonoids (4.02%), Saponin (3.5%), Phenols (5.57 mg/kg), tannin (9.13%), Oxalate (0.162%), Haemagglutinin (1.8814 mg/kg), Phytate (1.2967 mg/kg), and Cardiac Glycoside (1.6%) [14]. Gallic acid molecules and glucose combine to form tannic acid. It is astringent, antibacterial, and anti-enzymatic [15]. The antibacterial activity of the aqueous extract of Banana pseudo stem revealed the highest zone of inhibition to be 21 mm against *Streptococcus sp.* compared to 14 mm of methanolic extract [14]. The extract from the pseudo banana stem (*Musa paridasiaca*) had the most potent antibacterial impact on *Staphylococcus aureus*. Other strains, such as *Bacillus subtilis*, *Bacillus cereus*, and *E. coli*, also showed anti-microbial effect but was less efficient compared to commercially available antibiotic ampicillin [16].

### Wound Healing Property

According to previous research, banana stems have the ability to enhance macrophage numbers, which speeds up the healing process after wounds, as it includes phytochemicals such as ascorbic acid, lycopene, saponin, tannin, flavonoid, and beta-carotene. Inflammation can be decreased by tannin's anti-microbial activity. It causes the blood vessels to tighten and stimulates epithelial formation. This research aimed to see how effective *Musa acuminata* Stem Extract (MASE) is on traumatic oral ulcers in rats. The results revealed that a 25% ethanol extract of *Mauli* banana stem in the rats increased the thickness of the oral mucosa epithelium on the third day (51.26 m), fifth day (108.49 m), and seventh day (170.66 m). The mucosa epithelium thickened to its maximum on the seventh day. Thus, it was determined that 25% of ethanol extract on *Mauli* bananas might fasten the thickness of the mouth mucosa during the healing process [17].

According to a prior study, *Mauli* banana stem extract gel at a concentration of 37.5% can hasten the healing of traumatic ulcers by boosting the fibroblast cell count. Through fibroblast proliferation and ECM (Extracellular Matrix Reorganization) formation, the bioactive ingredient in banana stem juice can serve as an immunomodulatory agent to speed up the healing of wounds [18]. Another source of support is earlier research by Prasetyo. Researchers concluded that the Ambon banana stem, a type of banana, also can speed up the process of wound healing. It has an impact on the inflammatory cells, accelerating the

epithelialization, angiogenesis, and connective tissue creation processes [19].

### **Anti-Cancer Effect**

The *in vitro* and *in vivo* analysis of polyphenolic components in bananas revealed a predominance of flavonoids, cinnamic acids, and other compounds with chemopreventive potential. Aqueous methanol extract of the banana peel of *Nendran* showed substantial anti-cancer activity against the MCF-7 breast cancer cell line by triggering concentration-dependent apoptosis *in vitro* tests [20]. Banana peel and pulp in hexane showed *in vitro* anti-cancer activity against the HCT-116 colon carcinoma cell line. It was shown that the peel and pulp extract prevented the proliferation of HCT-116 cells and stopped cell growth by producing cytotoxicity [21].

### **Anti-Oxidant Activity**

The antioxidant activity of *Musa* extract mediated Copper-based nanoparticles (Cu-NPs) improves the treatment of disorders associated with ROS by increasing the capacity of different anti-oxidants to scavenge free radicals. Particularly Cu-NPs exhibit exceptional catalytic activity for scavenging  $H_2O_2$  and  $O_2^-$  but not  $OH^-$ . They can also activate electron transfer processes to render  $H_2O_2$  or  $OH^-$  inactive [22]. The highest bioactive compound in the bananas stem is tannin and then followed by ascorbic acid, saponin,  $\beta$ -carotene, total flavonoid, lycopene, alkaloid, and flavonoid which can trap free radicals and prevent cell damage [23]. Previous studies revealed that the chemical constituents in the sap of banana stems have anti-oxidant properties and are involved in the healing process. Moreover, they can shorten bleeding and clotting time due to the activation of clotting factors and the response of endothelial glycoprotein-Ib (GPIB) [24].

### **Anti-Helminthic Activity**

*M. paradisiaca* cv. Puttabale is a plant that has historically been used to get rid of parasitic worms. Sincere efforts have been performed to explore the anthelmintic activity from corm ethanol extracts of *M. paradisiaca* cv. Puttabale utilizes *Pheretima Posthuma* as an experimental model in order to support the ethnomedicinal claim with scientific evidence. This study investigates their impact on the duration of worm paralysis and death. The findings suggest that the ethanol extract at a dosage of 100 mg/ml had a significant impact on paralysis time at 42.331.45 min and death time at 54.000.58 min compared to the

control group paralysis time at 142.671.45 min and death time at 168.001.53 min. Piperazine citrate, a common medication, caused death at 59.0 min and paralysis at 39.67 min. The anti-helminthic and hypoglycaemic effect of banana stem juice is due to the abundant content of pectin and lignin [25].

### **Anti-Urolithic Activity**

Banana stem juice is low in calories, high in dietary fiber, and promotes the delayed release of simple sugars. It also has a low glycaemic index and helps with digestion and bowel movements. It works as a diuretic to flush out toxins that have built up in the body and regularly cleans the urinary tract. The banana stem juice has aided in the breakdown of kidney stones already present and also helps to avoid the build-up of various kidney stones in the urine bladder [26]. This is due to the presence of inorganic constituents like magnesium, potassium, and nitrate. Magnesium nitrate and potassium nitrate are the major active constituents present in the *Musa* stem juice, which acts as crystal inhibitors and hence aid in treating and preventing kidney stones [27]. Saponin, flavonoids, and terpenoids in the banana stem juice are the biochemical components responsible for the diuretic effect [2].

## **CONCLUSIONS**

This review of the pharmacological properties of banana stem juice gives detailed scientific evidence and information on traditional uses of the banana plant, nutritive value, the presence of phytochemical compounds, such as flavonoids, dietary fibers, tannins, saponins, and vitamins, which generally contribute to its various pharmacological properties such as anti-diabetic, anti-inflammatory, anti-microbial, wound healing, anti-cancer, anti-oxidant, anti-helminthic, anti-urolithic properties, which are scientifically valid. *Musa* stem juice may be useful to overcome the side effects of surgical procedures, which is the reoccurrence of kidney stones. This review will throw some light on the pharmacological and medicinal properties of bananas.

## **ETHICAL APPROVAL**

Ethical approval was not required for the study.

## **CONFLICTS OF INTEREST**

All the authors declare that there are no conflicts of interest.

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