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Review Article

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# *Musa acuminata*: From Daily Normal Eating to Treating Complex Diseases

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## ABSTRACT

Musa acuminata (Musaceae) is a tropical and subtropical perennial tree-like plant that grows in various tropical and subtropical locations throughout the world. Because of its nutrient-dense diet and varied medicinal qualities, bananas, which may be eaten as a fruit or a vegetable, are one of the most important crops in many countries. Bananas include apigenin glycosides, myricetin glycoside, myricetin-3-O-rutinoside, delphinidin, pelargonidin, peonidin, malvidin, naringenin glycosides, kaempferol-3-O-rutinoside, dopamine, N-acetyl serotonin, rutin, polyphenols, flavonoids, total dietary fibre, The main aim of this study is to validate and highlight M. acuminata's medicinal and nutritional benefits. According to a literature study, fever, cough, bronchitis, dysentery, allergy diseases, sexually transmitted infections, and some non-communicable disorders have all been related to M. acuminata. Antioxidant, anti-diabetic, immunomodulatory, hypolipidemic, anti-cancer, and anti-microbial activities have been found for M. acuminata. Pharmacological investigations support the medicinal plant's traditional importance, indicating that indigenous peoples utilised M. acuminata to treat and cure a wide range of diseases and disorders. Individual bioactive constituent(s) from distinct parts of this plant, on the other hand, need to be investigated further in order to verify various pharmacological claims and to explore the potential of M. acuminata in drug development and use in functional foods. In order to create efficient disease prevention and management strategies, a comprehensive study of M. acuminata's biological activity is given, as well as possible mechanisms and phytochemicals involved.

**Key Words:** *Musa acuminata*, Banana, Pharmacology, Phytochemistry, Botanical, Nutritive value

## INTRODUCTION

Botanicals have always played a significant role in medicine and wellness. According to ethnobotanical literature, plant extracts, infusions, and powders have been utilised for centuries to cure a range of ailments. In many cultures throughout the world, plant parts have long been the sole method to treat diseases and injuries, and they are still utilised as a traditional treatment in many areas today. Many of these plants have been used only on the basis of folklore, but studies now demonstrate that they work. Traditional medicine is utilised by a significant percentage of the population in poor countries for basic health care, according to the World Health Organization (WHO). As a consequence, demand for medicinal plants is increasing in both developing and developed countries. However, the most majority are being harvested from natural sources without scientific oversight, putting numerous species at risk. A well-balanced diet should include fruits and vegetables. Bananas, for example, are high in antioxidants and have many health benefits. This is due in part to the fact that bananas aid in the retention of calcium, nitrogen, and phosphorus in the body, all of which aid in the development of healthy and regenerated tissues. Musa acuminata (Figure 1) is an indigenous Southeast Asian wild banana species. Several parts of the Musa plants have been used orally or topically as remedies in traditional medicine, and some research has verified this. It possesses a broad variety of pharmacological characteristics, with research suggesting that the phenolic compounds present in M. acuminata play a significant part in this. All parts of the plant have long been used in local and traditional medicine throughout America, Asia, Oceania, India, and Africa, including the roots, stem, pseudostems, leaves, fruits, and flowers. This review paper emphasises the importance of different M. acuminata plant components for food and medicinal. There's also a comprehensive

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breakdown of the edible fruit's composition and nutritional worth. The biological activity of different plant components, as well as possible processes and phytochemicals involved, are all thoroughly examined. [1]

## TAXONOMY [2]

**Kingdom:** Plantae

**Subkingdom:** Viridiplantae

**Infrakingdom:** Streptophyta

**Superkingdom:** Embryophyta

**Division:** Tracheophyta

**Subdivision:** Spermatophytina

**Class:** Magnoliopsida

**Superorder:** Lilianae

**Order:** Zingiberales

**Family:** Musaceae

**Genus:** Musa

**Species:** acuminata

## DISTRIBUTION

The number of species of M. acuminata is very diverse. The most generally recognised species are as follows: M. chinensis Sweet, M. cavendishii Lamb, M. nana Lour, M. corniculata Kurz, M. rumphiana Kurz, M. sapientum var. suaveolens Blanco Malag, M. sinensisSagot ex Bake, M. simiarumKurz, M. sapientum var. suaveolens Blanco Malag, M. sapientum var. su M. acuminata subsp. burmannica, M. acuminata subsp. acuminata, M. acuminata subsp. acuminata, M. acuminata subsp. halabanensis, M. acuminata subsp. errans, M. acuminata subsp. microcarpa, M. acuminata subsp. malaccensis, M. acuminat [3]

M. acuminata is a Musaceae species that may be found in the hot, tropical regions of Southeast Asia. Malaysia is believed to be the primary source of M. acuminata, which has a wide range of distribution. Later, it spread to India and Burma, where it thrived alongside the native M. balbisiana species. Natural hybridization of M. acuminata and M. balbisiana occurred in the Indo-Burman peripheral area, resulting in triploid AAA banana cultivars, and India is therefore regarded the primary point of origin for more than 300 different banana cultivars out of 600 different Musa germplasm types. Bananas are mentioned in ancient Indian treatises such as the Ramayana (2000 BC), Arthsastra (250 BC), and Chilappthikaram (500 AD), indicating that the banana fruit has long been cultivated in India. Antonius Musa, a Roman physician and botanist who lived from 63 BC to 14 AD, was honoured with the genus name, while acuminata alludes to the pointed apex of the fruits. M. acuminata has been discovered in the Kaziranga forest range of Assam, the Khasi hill ranges of Meghalaya, the southern and middle Andamans, and the Western Ghats of Karnataka. M. acuminata is currently grown in many countries across the world, with the main producers being Brazil, China, India, Ecuador, Columbia, and Venezuela. [4]

## PLANT DESCRIPTION

Plants may generate a modest number of stems (1-2) or a huge number of stems (100+). (4-6). The petioles and leaf sheaths have a glaucous or pruinose look. Leaf blades are rectangular, 2.0-2.5 m long, 0.4-0.6 m wide, truncated at the apex, and usually rounded at the base; nevertheless, leaf blades with one side rounded and the other acute have been seen. Vertically or subhorizontally, the inflorescence is deflexed. Fruits feature a pedicel of about 1 cm in length at the base and a prominent acumen of 0.6-1.5 cm in length at the apex. The pericarp is around 2 mm thick and bright yellow when fully mature, while the pulp is white to cream-yellow to yellow in colour. Seeds are 6- 7 mm in length and 3 mm in height and are irregularly angulate, dull black, smooth, or minutely tuberculate. [5]

## PHYTOCHEMICAL PROFILE

Saponins, terpenoids, steroids, anthocyanins, fatty acids, tannins, phenols, and alkaloids have been found in M. acuminata's fruit, peel, flower, leaf, pseudostem, and rhizome, among other parts of the plant. The quantity of phytochemicals discovered varies depending on the extraction method and the compounds present in various parts of the M. acuminata plant. Plants continue to be a major source of bioactive chemicals, and creating new chemical compounds necessitates a multidisciplinary strategy that incorporates ethnobotanical, phytochemical, and biological techniques. Bioactive compounds including apigenin-7-glucoside, myricetin-3-O-galactoside, myricetin-3-O-rutinoside, naringenin-7-O-glucoside, kaempferol-3-O-rutinoside, dopamine, N-acetyl serotonin, and rutin have been discovered in several Musa cultivars. [6]

## NUTRITION LEVEL

Bananas, a calorie-dense tropical fruit, provide great nutrition in a number of ways. Bananas, a calorie-dense tropical fruit, provide great nutrition in a number of ways. The Musa family contains starch, fructans, phenolic acid, anthocyanins, terpenoids, and sterols. Starch accounts for

about 80% of the dry weight of unripe plantain pulp. Because plantains and bananas have a low fat content (about 0.5%), fats do not contribute substantially to the energy content. When measured by dry weight, plantain has a total protein value of more than 3.5 percent in mature pulp and slightly less in fresh fruit. In unripe plantains, sugars account for around 1.3 percent of total dry matter, while in mature plantains, this figure increases to about 17 percent. It is high in carotene (vitamin A), thiamine (vitamin B1), riboflavin (vitamin B2), riboflavin (vitamin B3), niacin (vitamin B3), pyridoxine (vitamin B6, required for the treatment and management of neuritis and anaemia), and ascorbic acid (vitamin C). It also helps to lower homocysteine levels, which are a contributing factor in coronary artery disease (CAD) and stroke. Potassium, an important component of cell and body fluids, aids in the correct functioning of muscles and neurons. Bananas are rich in potassium and have a high carbohydrate content. Potassium is beneficial to muscles because it maintains them in excellent working order and prevents muscle spasms. New study also indicates that potassium may help those with potassium shortage reduce their blood pressure. Potassium also reduces the risk of stroke. Magnesium, like manganese, is essential for strong bones and has a role in the heart. Manganese is a co-factor in the oxidation of superoxide dismutase in the body. Copper is often utilised in the production of RBCs. Bananas are high in fructose and sugars. It instantly revitalises the body and restores vitality. It includes the health-promoting flavonoid and polyphenolic antioxidants lutein and zeaxanthin. It contains small quantities of alpha- and beta-carotenes. These molecules serve as scavengers, neutralising free radicals and reactive oxygen species (ROS) produced by oxygen. Bananas are high in fatty acids, phytosterols, and sterylglucosides. Steryl esters and free sterols such campesterol, beta-sitosterol, cycloartenol, and stigmasterol are the most lipophilic components found in unripe banana peels. Steryl esters and free sterols are the major lipophilic components found in unripe banana peels, while free fatty acids and sterols prevail in banana pulp. Banana fruits are high in essential mineral components and may be utilised as a source of minerals in human and animal diets. [7,8]

## PHARMACOLOGICAL POTENTIALS

The rich and varied content of phytochemicals discovered in various parts of the M. acuminata plant has shown promise in traditional medicine for disease prevention, which may be attributed to their rich and diverse content of phytochemicals. The health-promoting properties of M. acuminata have been studied utilising a number of models, which are discussed below in terms of in vitro and in vivo models.

### Cholesterol reducing activity

The anti-oxidant characteristics of saponin, tannin, and flavonoid in kepok banana peel are responsible for reducing blood total cholesterol levels. The aim of this study was to investigate whether saponin, tannin, and flavonoid contained in kepok banana peels might help obese mice reduce their total blood cholesterol levels. Twenty obese male Musmusculus L. strain Deutschland-Denken-Yoken mice were divided into four groups: normal control, obese control, and groups administered Kepok Banana Peel M. acuminata extract treatment at dosages of 8.4 mg/day and 16.8 mg/day. It took 14 days to finish the treatment. The total cholesterol levels of each group were determined using a spectrophotometer. The results of a one-way ANOVA test were p=0,000. In most instances, the Post-Hoc Test showed significant differences between groups. Obese mice that were given kepok banana peel had lower overall cholesterol levels. When compared to banana peel extract (BPE) at 16.8 mg/day, kapok BPE at 8.4 mg/day reduces total blood cholesterol substantially. The anti-cholesterol action of banana fibre ethanol extract resulted in a significant decrease in total cholesterol in obese male mice strain Deutschland-Denken-Yoken. [9]

### Anti-oxidant activity

Despite the fact that banana fruits (M. acuminate Juss.) are nutrient-dense, little study has been done on the phenolics present in their cell walls. (+)-catechin, gallocatechin, and (-)-epicatechin, as well as condensed tannins, were identified in the soluble extract of the fruit pulp; however, no soluble anthocyanidins or anthocyanins were discovered. The soluble cell wall fraction was dominated by two hydroxycinnamic acid derivatives, whereas the insoluble cell wall fraction was dominated by the anthocyanidindelphinidin, which was identified for the first time in banana cell walls. The antioxidant capacity of cell wall fractions was linked with the total phenolic content released after the hydrolysis of the water-insoluble polymer, especially after acid and enzymatic hydrolysis, but not for the post-hydrolysis water-soluble polymer. Acid hydrolysis generated a diversity of monosaccharides, while enzyme hydrolysis created a single peak of oligosaccharides. These results indicate that banana cell walls may be an excellent source of natural antioxidants, and that they could be accessible in the human stomach. [10]

### Hepatoprotective potentials and Anti-ulcer activity

Natural therapies based on plants are still the preferred treatment since they are effective, safe, and have minimal adverse effects. M. acuminata was studied for its hepatoprotective, anti-ulcerogenic, anti-oxidant, and cytotoxic effects. Under certain conditions, methanolic

extracts of unripe M. acuminata were shown to be as effective as the commercial hepatoprotective medicine silymarin and the anti-ulcer drug omeprazole in an animal model. The extracts were non-cytotoxic and showed low to moderate antioxidant activity. These positive effects may be due to saponins, flavonoids, and triterpenes in the peel and pulp extracts, as well as tannins in the peel extract. More study is required to enhance the extraction of bioactive compounds that interact to produce the ameliorative or protective effects shown in our studies. [11]

## Anti-cancer activity

Total phenols and flavonoids, as well as anticancer and antioxidant activities, were measured in ethanol extracts of three plants: Phoenix dactylifera, M. acuminata, and Cucurbita maxima. The total phenolic content of ethanol extract of banana fruit was estimated to be 342 g/mL gallic acid equivalents, whereas the highest total flavonoids were discovered in ethanol extract of molasses date 1424 M as rutin equivalent. Anticancer properties were tested in vitro using EACC and HeLa cell lines. The ethanol extract of pumpkin seeds 100 percent at 100 g/mL showed the highest inhibition against the EACC cell line, whereas the ethanol extract of date seeds 90 percent at 100 g/mL showed the greatest inhibition against the HeLa cell line. Antioxidant activity was measured using three different methods: DPPH, ABTS scavenging activity, and reducing power. The DPPH scavenging activity of ethanol extracts of date seed and banana fruit was found to be 85 percent and 84 percent, respectively. ABTS scavenging activity was found to be 98 percent, 98 percent, 95 percent, and 95 percent in ethanol extracts of seeds, molasses of date, fruit, and peel of a banana, respectively. The reducing power of ethanol extracts of molasses, seeds, and fruit of dates was 873 g/mL, 833 g/mL, and 871 g/mL GAE, respectively. The plants were used to make four different formulations, and sensory assessments showed that the recipes were favourably accepted. According to the results, ethanol extracts of date parts, banana peels, and pumpkin seeds are possible new anti-oxidant and anti-cancer agents, with established formulations appropriate for daily use. Another study looked at the radioprotective and anti-cancer properties of banana peel extract on male mice. Sixty male mice weighing 18 g were utilised, and the mice were split into six groups: The first group behave normally, the second group tumour control implanted with Ehrlich tumour, the third group, the irradiated group exposed to a single dose of 3.0 GY gamma rays, the fourth group BPE 300 mg/kg/day orally for 3 weeks, the fifth group tumour implanted + BPE 300 mg/kg/day orally for 3 weeks, and the sixth group tumour implant. BPE substantially reduced the elevation of Carcinoembryonic antigen in the tumour implanted group, as well as the elevation of Malonaldehyde in both the tumour implanted and irradiation groups, as well as the elevation of Carcinoembryonic antigen in both the tumour implanted and irradiated groups. According to protein fractions and western blotting data, adding BPE has a substantial effect on Irradiation dosage, as shown by a 20% rise in polymorphism percent for addition BPE vs non-polymorphic Irradiation therapy. Furthermore, combining BPE with irradiation as a compound dosage increased P53 expression significantly. [12,13]

## Inhibitory activity

Musa species is a traditional Indian medicinal plant that is used to treat and prevent a wide range of illnesses. M. acuminata fruits and leaves were compared for anti-cholinesterase, anti-inflammatory, anti-oxidant, and anti-diabetic activities, and phytoconstituents were identified using HPTLC-HRMS and NMR. The pharmacological activity of leaf fractions is considerably greater than that of fruit. The ethyl acetate fraction of the leaf has a total phenolic content of 911.9 1.7 mg GAE/g and exhibits significant DPPH-scavenging activity with an IC50 of 9.0 0.4 g/mL. It also inhibits acetylcholinesterase and alpha-glucosidase (IC50s of 404.4 8.0 g/mL and 4.9 1.6 g/mL, respectively), but only weakly inhibits amylase (IC50 of 444.3 4.0 g/mL). The anti-inflammatory activity of the leaf fractions n-butanol (34.1 2.6 g/mL) and ethyl acetate (IC50, 43.1 11.3 g/mL) was higher than the positive control, quercetin (IC50, 54.8 17.1 g/mL). Kaempferol-3-O-rutinoside, quercetin-3-O-rutinoside, and rutin were identified as novel medicinal compounds with significant anti-oxidant and anti-diabetic effects in the ethyl acetate fraction of M. acuminata leaf. [14]

## Immunomodulatory activity

Using banana peels as a feed supplement, the effects of banana peel flour (BPF) on the growth and immune functions of Labeorohita were investigated. The fish were fed diets with five different doses of BPF over the course of 60 days: 0% baseline diet, 1% B1, 3% B3, 5% B5, and 7% B7. The B5 group showed a higher overall weight gain and a faster rate of specific growth. Immunological indicators such as lysozyme, alternative complement pathway, leukocyte phagocytic, superoxide dismutase, and catalase activity improved the most in the B5 group. The B5 group, on the other hand, had the least amount of malondialdehyde. With the exception of B1, the treatment groups' IgM and glutathione peroxidase activities were significantly enhanced after just 30 days of feeding. The expression of cytokine-related genes such as IL-1, TNF-alpha, and HSP70 was increased in the head kidney and hepatopancreas, with expression levels usually higher in the B3 and B5 groups. Furthermore, the B5 group had the highest survival rate of 70% after being exposed to Aeromonashydrophila 60 days after feeding. These results suggest that dietary BPF at a concentration of 5% may help L. rohita grow and develop its immune system. [15]

### Wound healing activity

The peel of a banana is high in carbohydrates and contains a variety of nutrients. For ages, it has been used to treat indigestion, anaemia, and ulcers. In certain research, banana peels were shown to have anti-inflammatory and antioxidant properties. The goal of this study was to determine whether BPE might help rabbits recover their wounds. Rabbits were given full-thickness wounds using an excisional wound model. The tensile strength of the wound tissue sample, as well as wound contraction and re-epithelialization rate, were utilised to assess healing. In histological studies, BPE was also shown to have wound-healing capabilities. The hydroalcoholic extract of banana peels has a great potential for wound healing, according to the results of this study, and may be used to treat a range of human wounds. [16]

### Anti-bacterial activity

The anti-bacterial activity of the M. acuminata leaf methanol extract coated sample against Staphylococcus aureus ATCC 6538, a gram-positive bacterium, and Escherichia coli, a gram-negative microorganism, was assessed qualitatively in an in vitro test. The ethanolic 96 percent, acetone, and petroleum ether extracts of M. acuminata leaf shown excellent anti-fungal action against two pathogenic fungus, Aspergillusterreus and Penicilliumsolitum, with inhibition zones up to 5.7 cm in diameter, at 20 mg/mL of the extract. Against Candida albicans, the inhibitory zone diameter of a produced gel preparation containing 4 percent M. acuminata leaf acetone extract was determined to be 27 mm, which was comparable to nystatin cream used as a control. [17]

### Anti-diabetic activity

The anti-hyperglycemic activity of ethanolic extract of M. acuminata fruit inner peels 100-400 mg/Kg p.o. was investigated using an oral glucose tolerance test in normoglycemic Wistar rats. The extract-treated group showed a dose-dependent anti-hyperglycemic effect in normoglycemic rats, but there was no significant p0.05 difference in blood glucose levels between the control, extract-treated, and drug-treated groups; however, extracts at 200 mg/kg and 400 mg/kg p.o. levels showed a significant decrease in p0.01 in blood glucose levels in glucose-loaded normoglycemic rats, which was not observed in the control, extract-treated, or drug-treated groups. [18]

### Anti-Leishmanial activity

In studies, it was found that phytoalexins from M. acuminata had leishmanicidal properties. The antifungal phenyl-phenalenonephytoalexin REF20 and anigorufone compounds from M. acuminata's rhizomes were shown to target the mitochondria of Leishmaniadonovanipromastigotes and L. infantumamastigotes. With LC50s of 10.3 g/mL and 10.5 g/mL, respectively, the REF20 exhibited a somewhat greater inhibitory effect on L. donovani and L. infantum proliferation than the anigorufone, which had LC50s of 12.0 g/mL and 13.3 g/mL, respectively. In mitochondrial fractions, the extracts also decreased the activity of succinate dehydrogenase (SDH) and fumaratereductase (FRD). REF20 showed a higher EC50 value for SDH (59.6 g/mL) than anigorufone (33.5 g/mL), but lower FRD 47.8 g/mL and 53.1 g/mL, and purified-FRD 77.2 g/mL and 89.0 g/mL values than anigorufone. These results indicate that phenylphenalenonephytoalexins may be used as a new structural motif for leishmanicidal activity, and that they could be used to develop leishmanicidal drugs. [19]

## TOXICITY

The fruit and other parts of M. acuminata are nontoxic, according to what is known about their use by local and tribal people. Despite their lack of popularity, indigenous peoples consume fruits and other plant components all over the world. M. acuminata flowers have been consumed in Sri Lanka for generations as a curried, boiled, or deep-fried salad. In the animal models used in several studies, the administration of M. acuminata extracts had no deleterious consequences. A cell line of murine monocytic macrophages was shown to be unaffected by M. acuminata's blooming stalk. With an LC50 result of 9.97 mg/mL, much greater than the toxicity cutoff level of 1.0 mg/mL, the toxicity test on Artemiasalina showed that M. acuminata flower extract was not harmful. M. acuminata peel is often used in culinary preparations, indicating that it is safe to consume. Human cells are unaffected by the skin of a banana. [20]

## CONCLUSION

All accessible information on M. acuminata was gathered via an electronic search of published papers in Pubmed, Scopus, Web of Science, Science Direct, Google Scholar, and other databases. As a result, this study may serve as a scientific foundation for future research on M. acuminata in order to create phytomedicines and edible items with useful characteristics. The contents of M. acuminata fruits may contribute to the required daily needs of Vitamin C and minerals such as potassium and magnesium, and it can be utilised as a functional food component, according to proximate analysis. The wide range of phytochemicals found in M. acuminata plant parts may be responsible for health benefits, justifying its use in traditional medicine for a variety of illnesses. Some research on animal models against certain pathological diseases demonstrate the effectiveness of the M. acuminata plant as a medicinal agent, and praise the usage of M. acuminata by different tribes and ethnic groups throughout the globe. Plant parts of M. acuminata have been eaten in various amounts and forms by numerous

people throughout the world for a long time, with no toxicity recorded. However, the fruits of M. acuminata, which are high in energy, vitamins, and minerals, are seldom eaten, and the culinary application of other plant parts is also unknown, opening the way for the creation of food items with possible health advantages from M. acuminata. M. acuminata has long been used to treat a variety of illnesses and disorders, including fever, bronchitis, allergic responses, sexually transmitted infections, and certain non-communicable diseases. Traditional medicine has used all parts of the plant, including the fruit, stem, pseudostem, flower, leaf, sap, inner trunk, inner core, and root. Antihypertensive, antidiabetic, anthelmintic, and anti-HIV chemicals identified from M. acuminata have historically been used to treat TB and other respiratory illnesses. M. acuminata has been utilised in antibacterial gel formulations, and its therapeutic efficacy in conjunction with western medicine has been shown in a clinical trial; nevertheless, the potential of some of the plant's components in disease prevention is unknown, and further research is needed. There are promising phytochemicals present in M. acuminata, such as (+)-6-methoxy—methyl-2-naphthaleneacetic acid anti-inflammatory activity, BanLec anti-HIV-1 activity, and others, that show promising wound healing, anti-tuberculosis, and Leishmanicidal activity, and that need to be taken to clinical trials for possible drug development. Another M. acuminata bioactive component, s, requires further research to verify different pharmacological claims and to investigate their potential application in medication development and as a functional food additive. Characterization of different phytochemicals found in M. acuminata that interact individually or synergistically with other compounds or recognised medicines to offer ameliorative or protective effects against a variety of illnesses is also needed.

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## CONFLICT OF INTEREST

The authors declare no Conflict of Interest regarding the publication of the article.

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