

## Banana (*Musa acuminata*): Most popular and common Indian plant with multiple pharmacological potentials

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### Abstract

**Background:** *Musa acuminata* (Musaceae) is a perennial tree-like plant that is grown in many tropical and subtropical areas throughout the globe. Bananas, which may be consumed as a fruit or a vegetable, is one of the most significant crops in many nations owing to their nutrient-dense diet and diverse therapeutic properties.

**Introduction:** 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 fiber, insoluble dietary fiber, lignin, hemicellulose, cellulose, lipids, proteins, and minerals are found in bananas.

**Objective:** The primary goal of this research is to confirm and emphasize the therapeutic and nutritional value of *M. acuminata*.

**Methods:** Fever, cough, bronchitis, dysentery, allergy infections, sexually transmitted infections, and certain non-communicable illnesses have all been linked to *M. acuminata*, according to a literature review.

**Result:** *M. acuminata* has been reported to have anti-oxidant, anti-diabetic, immunomodulatory, hypolipidemic, anti-cancer, and anti-microbial properties. Pharmacological studies back up the medicinal plant's traditional significance and suggest that indigenous peoples used *M. acuminata* to cure and heal a variety of illnesses and ailments. Individual bioactive constituent(s) from different sections of this plant, on the other hand, need to be studied further to validate various pharmacological claims and to investigate the potential of *M. acuminata* in drug development and usage in functional foods.

**Conclusion:** A thorough examination of *M. acuminata*'s biological activity is provided, as well as potential processes and phytochemicals involved, in order to develop effective disease prevention and management methods.

**Keywords:** *Musa acuminata*; Banana; Pharmacology; Phytochemistry; Botanical; Nutritive value

### 1. Introduction

Botanicals have been very important for medicine and health throughout evolution. Plant extracts, infusions, and powders have been used traditionally for years to treat a variety of illnesses, according to ethnobotanical literature.

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Plant parts have long been the only way to cure illnesses and injuries in many civilizations throughout the globe, and they are still used as a traditional therapy in many places today. Many of these herbs have been used purely on the basis of a traditional belief, but studies are now showing that they are effective. According to the World Health Organization (WHO), traditional medicine is used by a large portion of the population in developing nations for basic health care. As a result, both emerging and industrialized nations are seeing a rise in demand for medicinal herbs. However, the majority of them are still taken from natural sources without scientific control, putting many species in jeopardy. Fruits and vegetables are an essential part of a balanced diet. Bananas, for example, provide many health advantages. This is partially due to the fact that bananas help the body retain calcium, nitrogen, and phosphorus, all of which contribute to the formation of healthy and regenerated tissues. *Musa Acuminata* (Figure 1) is a wild banana species endemic to Southeast Asia. In traditional medicine, several portions of the *Musa* plants have been used orally or topically as treatments, and some investigations have confirmed this medicinal potential. It has a wide range of pharmacological properties, with studies indicating that phenolic chemicals found in *M. acuminata* play a major role in this characteristic. In America, Asia, Oceania, India, and Africa, all parts of the plant, including the roots, stem, pseudostems, leaves, fruits, and flowers, have long been utilized in local and traditional medicine. The significance of various components of the *M. acuminata* plant for food and medicine is highlighted in this review article. An integrated profile of the edible fruit's composition and nutritional value is also provided. A thorough examination of the biological activity of various plant components is provided, as well as potential processes and phytochemicals involved [1].



**Figure 1** Indian banana tree

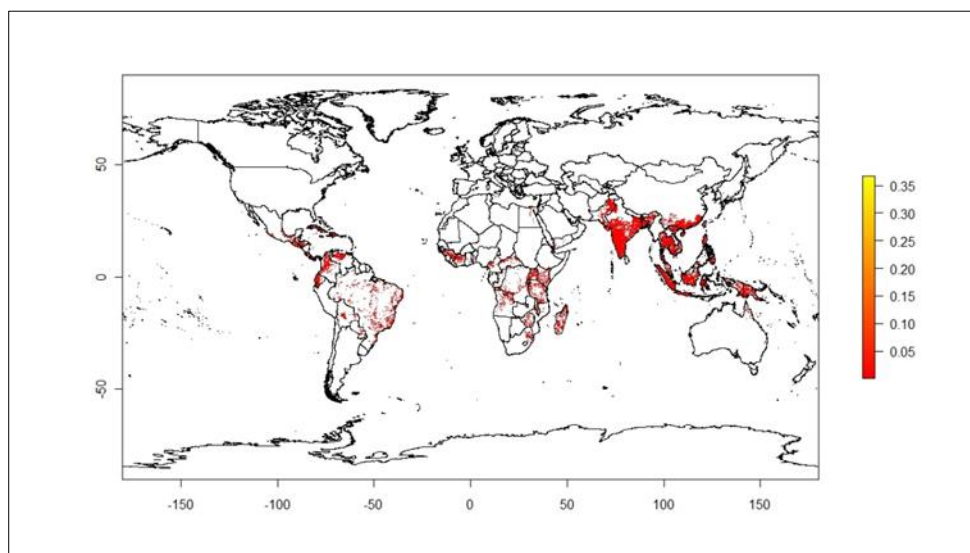
#### TAXONOMY

- Kingdom: Plantae
- Subkingdom: Viridiplantae
- Infrakingdom: Streptophyta
- Superkingdom: Embryophyta
- Division: Tracheophyta
- Subdivision: Spermatophytina
- Class: Magnoliopsida
- Superorder: Lillanae
- Order: Zingiberales
- Family: Musaceae
- Genus: *Musa*
- Species: *acuminata* [2]

## 2. Distribution

*M. acuminata* is highly variable and the number of species. The following are the most commonly accepted species are *M. chinensis* Sweet, *M. cavendishii* Lamb, *M. nana* Lour, *M. corniculata* Kurz, *M. rumphiana* Kurz, *M. sapientum* var. *suaveolens* Blanco Malag, *M. sinensis* Sagot ex Bake, *M. simiarum* Kurz, etc. *M. acuminata* exhibits considerable variation and has been split up into eight subspecies namely *M. acuminata* subsp. *burmannica*, *M. acuminata* subsp. *acuminata*, *M. acuminata* subsp. *halabanensis*, *M. acuminata* subsp. *errans*, *M. acuminata* subsp. *microcarpa*, *M. acuminata* subsp. *malaccensis*, *M. acuminata* subsp. *truncate*, *M. acuminata* subsp. *siamea*, and three varieties namely *M. acuminata* var. *sumatrana*, *M. acuminata* var. *tomentosa*, and *M. acuminata* var. *chinensis* [3].

*M. acuminata* is a Musaceae species that may be found in Southeast Asia's hot, tropical areas. *M. acuminata* has a broad range of distribution, and Malaysia is thought to be the main source of *M. acuminata*. Later, it migrated to India and Burma, where the native *M. balbisiana* species thrives. Natural hybridization of both *M. acuminata* and *M. balbisiana* happened in the Indo-Burman periphery region, resulting in triploid AAA banana cultivars, and India is therefore considered as the main center of origin for more than 300 kinds of banana cultivars out of 600 types of *Musa* germplasm. The mention of bananas in ancient Indian treatises like the Ramayana (2000 BC), Arthashastra (250 BC), and Chilappthikaram (500 AD) indicates that the banana fruit has been domesticated in India for a long time. The genus name was chosen to commemorate Antonius Musa, a Roman physician and botanist who lived from 63 BC to 14 AD, while the species name *acuminata* refers to the pointed apex of the fruits. *M. acuminata* has been found in the natural habitats of Assam's Kaziranga forest range, Meghalaya's Khasi hill ranges, the southern and middle Andamans, and Karnataka's Western Ghats. *M. acuminata* is now cultivated in numerous countries across the globe, with Brazil, China, India, Ecuador, Columbia, and Venezuela being the top producers [4].



**Figure 2** Distribution of banana plants across the globe

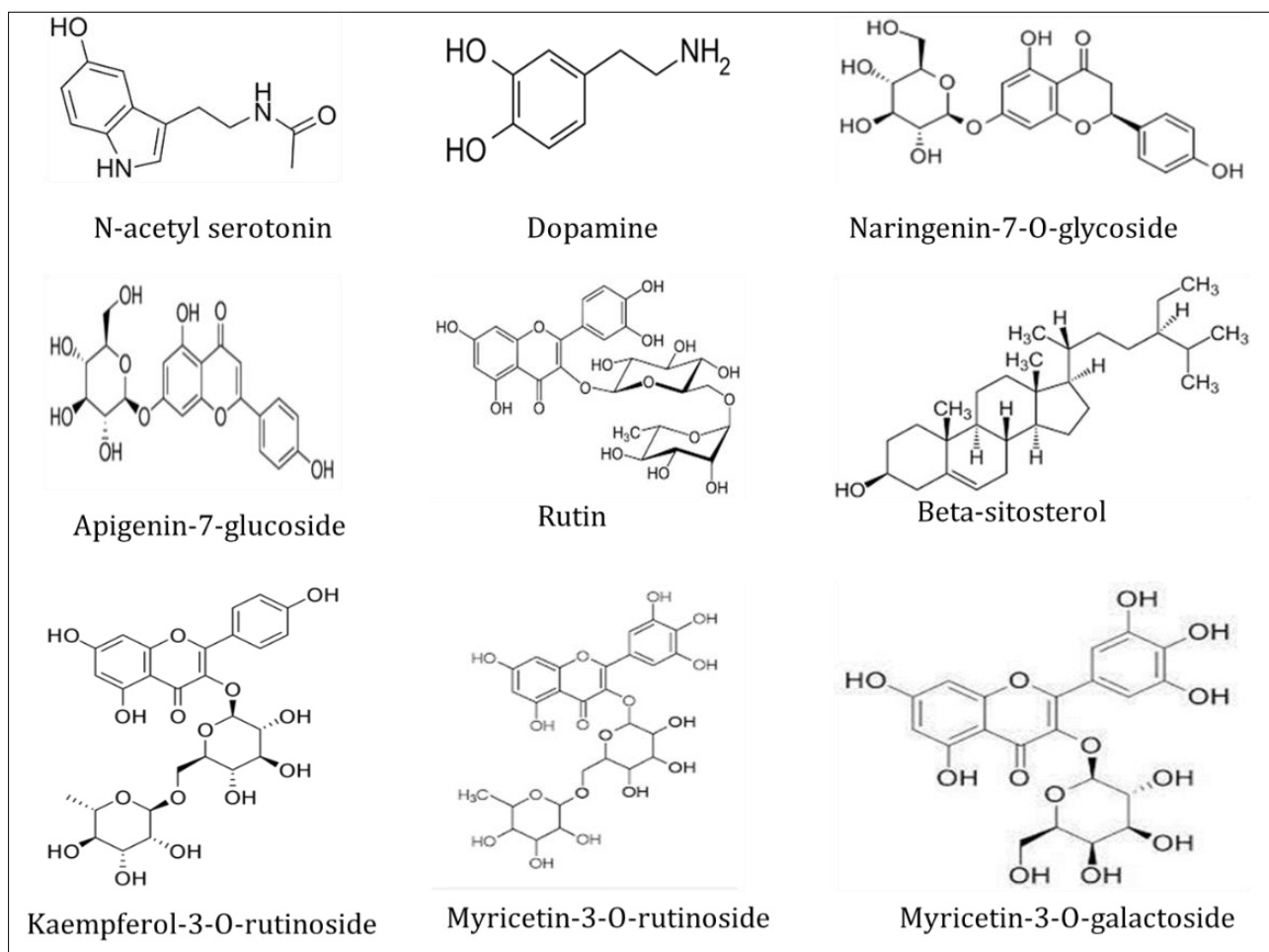
**Source:** Free Image Sources (No Copyright Required)

## 3. Plant description

The plants are perennial and produce a small number of stems (1-2) or a large number of stems (4-6). The leaf sheaths and petioles are glaucous or pruinose in appearance. Leaf-blades are rectangular, 2.0-2.5 m long × 0.4-0.6 m broad, truncated at the apex, and typically rounded at the base; however, leaf blades that are rounded on one side and acute on the other have been recorded. The inflorescence is deflexed vertically or subhorizontally. Fruits have a pedicel of approximately 1 cm at the base and a conspicuous acumen of 0.6-1.5 cm length at the apex. At full maturity, the pericarp is approximately 2 mm thick and brilliant yellow in color, while the pulp is white to cream-yellow to yellow in hue. Seeds are irregularly angulate, dull black, smooth, or minutely tuberculate, and measure 6- 7 mm in length and 3 mm in height [5].

#### 4. Phytochemical profile

The presence of a wide variety of phytochemicals such as saponins, terpenoids, steroids, anthocyanins, fatty acids, tannins, phenols, and alkaloids has been discovered in several sections of *M. acuminata*, including the fruit, peel, flower, leaf, pseudostem, and rhizome. The amount of phytochemicals found varies depending on the extraction technique used and the compounds found in different sections of the *M. acuminata* plant. Plants continue to be a significant source of bioactive chemicals, and developing novel chemical compounds requires a multidisciplinary approach integrating ethnobotanical, phytochemical, and biological methods. Different varieties of *Musa* have been found to contain bioactive substances such as 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 (Figure 3) [6].



**Figure 3** Phytochemicals present in various species of banana

#### 5. Nutrition level

Bananas, a high-calorie tropical fruit, offer excellent nourishment in a variety of ways. Bananas, a high-calorie tropical fruit, offer excellent nourishment in a variety of ways. Starch, fructans, phenolic acid, anthocyanins, terpenoids, and sterols are all found in the *Musa* family. Starch makes up more than 80 percent of the dry weight of unripe plantains' pulp. Plantains and bananas have relatively low-fat content (approximately 0.5 percent), therefore fats do not add significantly to the energy content. Plantain has a total protein value of more than 3.5 percent in ripe pulp and slightly less in fresh fruit as measured by dry weight. Sugars make up around 1.3 percent of total dry matter in unripe plantains, but this rises to approximately 17 percent in mature plantains. Carotene (vitamin A), Thiamine (vitamin B<sub>1</sub>), Riboflavin (vitamin B<sub>2</sub>), Niacin (vitamin B<sub>3</sub>), Pyridoxine (vitamin B<sub>6</sub>, necessary for the treatment and management of neuritis and anemia), and ascorbic acid are all abundant in it (vitamin C). Furthermore, it aids in the reduction of homocysteine, a causative component in coronary artery disease CHD and stroke events. Potassium, an essential component of cell and body fluids, helps muscles and neurons function properly. Bananas are high in potassium and contain a lot of starch. Potassium is good for muscles because it keeps them functioning properly and avoids muscular spasms. Furthermore,

new research suggests that potassium may assist those with potassium deficiency lower their blood pressure. Potassium also lowers the chance of a stroke. Magnesium, like manganese, is important for healthy bones and also plays a function in the heart. Manganese is a co-factor for the enzyme superoxide dismutase oxidation in the body. Copper is used extensively in the formation of RBCs. Fructose and sugars are abundant in bananas. It immediately restores energy and revitalizes the body. It contains lutein and zeaxanthin, which are health-promoting flavonoid and polyphenolic anti-oxidants. It includes trace amounts of alpha-carotenes and beta-carotenes. These chemicals function as scavengers, neutralizing oxygen-derived free radicals and reactive oxygen species, or ROS. Fatty acids, phytosterols, and steryl glucosides are abundant in bananas. The main lipophilic component discovered in the unripe banana peel is steryl esters and free sterols such as campesterol, beta-sitosterol, cycloartenol, and stigmasterol. The main lipophilic components identified in the unripe banana peels are steryl esters and free sterols, while free fatty acids and sterols predominate in the banana pulp. Banana fruits contain a significant amount of important mineral components and may be used as a mineral source in human and animal diets [7,8].

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## 6. Pharmacological potentials

The rich and diverse content of phytochemicals found in different sections of the *M. acuminata* plant has shown promise for illness prevention in traditional medicine, which may be due to their rich and diverse content of phytochemicals. The health-promoting effects of *M. acuminata* were investigated using a variety of models, and the available *in-vitro* and *in-vivo* models are described below.

### 6.1. Cholesterol reducing activity

The presence of saponin, tannin, and flavonoid in kepok banana peel confers anti-oxidant properties, which are responsible for lowering blood total cholesterol levels. The goal of this research was to see whether saponin, tannin, and flavonoid found in kepok banana peels may lower total blood cholesterol levels in obese mice. This study used 20 obese male mice of the *Mus musculus* L. strain Deutschland-Denken-Yoken, which were split into four groups: normal control, obese control, and groups given a Kepok Banana Peel *M. acuminata* extract therapy at doses of 8.4 mg/day and 16.8 mg/day. The therapy took 14 days to complete. A spectrophotometer was used to determine each group's total cholesterol level. In a one-way ANOVA test, the findings were  $p=0,000$ . Furthermore, the Post-Hoc Test revealed substantial differences across groups in most cases. Giving obese mice kepok banana peel had a positive impact on their total cholesterol levels. When compared to banana peel extract (BPE) at 16.8 mg/day, the impact of kapok BPE at 8.4 mg/day significantly lowers total blood cholesterol. In obese male mice strain Deutschland-Denken-Yoken, the anti-cholesterol activity of banana fiber ethanol extract resulted in a substantial reduction in total cholesterol [9].

### 6.2. Anti-oxidant activity

Although banana fruits (*M. acuminata* Juss.) are nutritious, there has been little research on the phenolics found in their cell walls. The soluble extract of the fruit pulp included (+)-catechin, galocatechin, and (-)-epicatechin, as well as condensed tannins; however, no soluble anthocyanidins or anthocyanins were found. Two hydroxycinnamic acid derivatives predominated in the soluble cell wall fraction, while the anthocyanidin delphinidin, which was discovered for the first time in banana cell walls, predominated in the insoluble cell wall fraction. The total phenolic content released following the hydrolysis of the water-insoluble polymer was associated with the anti-oxidant capacity of cell wall fractions, particularly after acid and enzymatic hydrolysis, but not for the post-hydrolysis water-soluble polymer. Enzymatic hydrolysis produced a single peak of oligosaccharides, while acid hydrolysis produced a variety of monosaccharides. These findings suggest that banana cell walls may be a good source of natural antioxidants and may be bioavailable in the human stomach [10].

### 6.3. Hepatoprotective potentials and Anti-ulcer activity

Plant-based natural treatments are still the preferred therapy since they are effective, safe, and have few side effects. The hepatoprotective, anti-ulcerogenic, anti-oxidant, and cytotoxic properties of *M. acuminata* were investigated. As shown in the animal model, the methanolic extracts of unripe *M. acuminata* exhibited comparable efficacy to the commercial hepatoprotective medication silymarin and anti-ulcer drug omeprazole under specific circumstances. The extracts had low to moderate anti-oxidant activity and were not cytotoxic. The saponins, flavonoids, and triterpenes in the peel and pulp extracts, as well as the tannins in the peel extract, may be responsible for these beneficial benefits. Additional research is needed to improve the extraction of bioactive chemicals that work together to generate the ameliorative or protective effects reported in our experiments [11].

#### 6.4. Anti-cancer activity

Ethanol extracts of three plants, *Phoenix dactylifera*, *M. acuminata*, and *Cucurbita maxima*, were tested for total phenols and flavonoids, as well as anti-cancer and anti-oxidant properties. The total phenolic content of ethanol extract of banana fruit was calculated to be 342 µg/mL gallic acid equivalents, whereas the greatest total flavonoids were found in ethanol extract of molasses date 1424 µM as rutin equivalent. EACC and HeLa cell lines were used to test anticancer activities *in vitro*. The greatest inhibition against the EACC cell line was found in ethanol extract of pumpkin seeds 100 percent at 100 µg/mL, whereas the maximum inhibition against the HeLa cell line was recorded in ethanol extract of date seeds 90 percent at 100 µg/mL. Three distinct techniques were used to evaluate antioxidant activity: DPPH, ABTS scavenging activity, and reducing power. In ethanol extracts of date seed and banana fruit, DPPH scavenging activity was reported to be 85 percent and 84 percent, respectively. In ethanol extracts of seeds, molasses of date, fruit, and peel of a banana, ABTS scavenging activity was reported to be 98 percent, 98 percent, 95 percent, and 95 percent, respectively. In ethanol extracts of molasses, seeds, and fruit of dates, the reducing power was 873 µg/mL, 833 µg/mL, and 871 µg/mL GAE, respectively. Four distinct formulae were created from the examined plants, and sensory evaluations revealed that the produced formulas were well received. The findings revealed that ethanol extracts of date parts, banana peels, and pumpkin seeds are potential novel anti-oxidant and anti-cancer agents, with developed formulations suitable for everyday usage. On male mice, another research was conducted to assess the radioprotective and anti-cancer effects of banana peel extract. Sixty male mice weighing 18 g were used, with the animals divided into six groups as follows: first group act normally, second group tumor control implanted with Ehrlich tumor, third group, the irradiated group exposed to a single dose of 3.0 GY gamma rays, fourth group BPE 300 mg/kg/day orally for 3 weeks, fifth group tumor implanted + BPE 300 mg/kg/day orally for 3 weeks, sixth group tumor implant. The results showed that BPE alleviated the changes in the irradiated and tumor groups, and significantly decreased  $p < 0.05$  the elevation of Carcinoembryonic antigen in the tumor implanted group, as well as the elevation of Malonaldehyde in both the tumor implanted and irradiated groups. According to protein fractions and western blotting data, it can be concluded that adding BPE has a significant impact on Irradiation dose, as evidenced by a 20 percent increase in polymorphism percent for addition BPE versus Irradiation treatment that did not reflect polymorphism. Furthermore, using BPE and irradiation as a compound dose resulted in a significant increase in P53 expression [12,13].

#### 6.5. Inhibitory activity

Musa species is a traditional Indian medicinal plant that is used to control and cure a variety of ailments. The anti-cholinesterase, anti-inflammatory, anti-oxidant, and anti-diabetic properties of *M. acuminata* fruits and leaves fractions were compared, and phytoconstituents were characterized using HPTLC-HRMS and NMR. Leaf fractions have much higher pharmacological activity than fruit. The total phenolic content of the ethyl acetate fraction of the leaf is  $911.9 \pm 1.7$  mg GAE/g, and it has substantial DPPH-scavenging activity with an  $IC_{50}$  of  $9.0 \pm 0.4$  µg/mL. It also inhibits acetylcholinesterase and alpha-glucosidase with  $IC_{50}$ s of  $404.4 \pm 8.0$  µg/mL and  $4.9 \pm 1.6$  µg/mL, respectively, but only moderately inhibits amylase with an  $IC_{50}$  of  $444.3 \pm 4.0$  µg/mL. The anti-inflammatory activity of *n*-butanol ( $34.1 \pm 2.6$  µg/mL) and ethyl acetate fractions ( $IC_{50}$ ,  $43.1 \pm 11.3$  µg/mL) fractions of the leaf was greater than the positive control, quercetin ( $IC_{50}$ ,  $54.8 \pm 17.1$  µg/mL). From the ethyl acetate fraction of *M. acuminata* leaf, kaempferol-3-O-rutinoside, quercetin-3-O-rutinoside, and rutin were discovered as new therapeutic agents with strong anti-oxidant and anti-diabetic properties [14].

#### 6.6. Immunomodulatory activity

The effects of banana peel flour (BPF) on the development and immunological functions of *Labeo rohita* were studied using banana peels as a feed supplement. For 60 days, the fish were given diets containing five different concentrations of BPF: 0 percent baseline diet, 1 percent B1, 3 percent B3, 5 percent B5, and 7 percent B7. The B5 group had a greater ultimate weight increase and specific growth rate. The B5 group showed the greatest improvement in immunological markers including lysozyme, alternative complement pathway, leukocyte phagocytic, superoxide dismutase, and catalase activity. The B5 group, on the other hand, had the lowest malondialdehyde activity. After just 30 days of eating, the treatment groups' IgM and glutathione peroxidase activity were substantially increased, with the exception of B1. IL-1, TNF-alpha, and HSP70, among the cytokine-related genes tested, were elevated in the head kidney and hepatopancreas, with expressions typically greater in the B3 and B5 groups. Furthermore, the B5 group, which was exposed to *Aeromonas hydrophila* 60 days after feeding, had the greatest survival rate of 70 percent. These findings indicate that dietary BPF at a concentration of 5 percent may boost growth and immunology in *L. rohita* [15].

#### 6.7. Wound healing activity

Banana peel is abundant in carbs and is a good source of several nutrients. It is been used to cure diarrhea, anemia, and ulcers for centuries. Banana peels have been found to have anti-oxidant and anti-inflammatory effects in certain studies. The purpose of this research was to see how effective BPE was in healing wounds in rabbits. The excisional wound

model was used to induce full-thickness wounds in rabbits. The wound contraction and re-epithelialization rate, as well as the tensile strength of the wound tissue sample, were used to evaluate healing. BPE has also been shown to have wound-healing properties in histopathological investigations. According to the findings of this research, the hydroalcoholic extract of banana peels has a high potential for wound healing and may be utilized to treat a variety of wounds in humans [16].

### 6.8. Anti-bacterial activity

*In vitro* test was performed to assess qualitatively the anti-bacterial activity of the *M. acuminata* leaf methanol extract coated sample against *Staphylococcus aureus* ATCC 6538, a gram-positive microorganism, and *Escherichia coli*, a gram-negative microorganism. At 20 mg/mL of the extract, the ethanolic 96 percent, acetone, and petroleum ether extracts of *M. acuminata* leaf exhibited good anti-fungal activity against two pathogenic fungi *Aspergillus terreus* and *Penicillium solitum*, with inhibition zones up to 5.7 cm in diameter. The inhibitory zone diameter of a prepared gel preparation containing 4 percent *M. acuminata* leaf acetone extract was found to be 27 mm against *Candida albicans*, which was similar to nystatin cream used as a control [17].

### 6.9. Anti-diabetic activity

Using an oral glucose tolerance test in normoglycemic Wistar rats, the anti-hyperglycemic effect of ethanolic extract of inner peels of *M. acuminata* fruit 100-400 mg/Kg p.o. was explored. In normoglycemic rats, the extract-treated group showed a dose-dependent anti-hyperglycemic effect, but no significant  $p < 0.05$  change in blood glucose levels was observed between the control, extract-treated, and drug-treated groups; however, extracts at 200 mg/kg and 400 mg/kg p.o. level showed a significant decrease in  $p < 0.01$  in blood glucose levels in glucose-loaded normoglycemic rats, which was almost similar to the extract-treated group [18].

### 6.10. Anti-Leishmanial activity

Phytoalexins from *M. acuminata* were discovered to have leishmanicidal action in research. The mitochondria of *Leishmania donovani* promastigotes and *L. infantum* amastigotes were targeted by the anti-fungal phenyl-phenalenone phytoalexin REF20 and anigorufone compounds from the rhizomes of *M. acuminata*. The REF20 showed a somewhat stronger inhibitory impact on *L. donovani* and *L. infantum* proliferation, with  $LC_{50}$ s of 10.3  $\mu\text{g/mL}$  and 10.5  $\mu\text{g/mL}$ , respectively than the anigorufone, which had  $LC_{50}$ s of 12.0  $\mu\text{g/mL}$  and 13.3  $\mu\text{g/mL}$ . Succinate dehydrogenase (SDH) and fumarate reductase (FRD) activity were also reduced by the extracts in mitochondrial fractions. REF20 had a greater  $EC_{50}$  value for SDH (59.6  $\mu\text{g/mL}$ ) than anigorufone (33.5  $\mu\text{g/mL}$ ); nevertheless, REF20 had lower FRD 47.8  $\mu\text{g/mL}$  and 53.1  $\mu\text{g/mL}$  and purified-FRD 77.2  $\mu\text{g/mL}$  and 89.0  $\mu\text{g/mL}$  values than anigorufone. These findings suggest that phenylphenalenone phytoalexins may be utilized as a novel structural motif for leishmanicidal action and that they could be exploited to create leishmanicidal medicines [19].

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## 7. Toxicity

According to what is known about the usage of *M. acuminata* fruit and other parts by local and tribal people, it is non-toxic. Fruit and other plant parts are eaten by indigenous people all throughout the globe, despite their lack of popularity. For centuries, the *M. acuminata* flower has been eaten as a curried, boiling, or deep-fried salad in Sri Lanka. The administration of *M. acuminata* extracts did not cause any negative effects in the animal models utilized in different investigations. *M. acuminata*'s flowering stalk was shown to be non-toxic to a cell line of murine monocytic macrophages. The toxicity test on *Artemia salina* revealed that *M. acuminata* flower extract was not hazardous, with an  $LC_{50}$  value of 9.97 mg/mL, which was considerably higher than the toxicity cutoff threshold of 1.0 mg/mL. The fact that *M. acuminata* peel is a common component in culinary items indicates that it is safe to eat. The banana peel is also non-toxic to human cells [20].

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## 8. Conclusion

All the available information on *M. acuminata* was collected via electronic search using Pubmed, Scopus, Web of Science, Science Direct, Google Scholar, etc. for published articles. This review, thus, may provide the scientific basis for future research work on *M. acuminata* for the development of phytomedicines as well as edible products with functional properties. The proximate analysis of *M. acuminata* fruits reveals that its contents can contribute to the recommended daily requirements of Vitamin C and minerals such as potassium and magnesium, and it can be used as an ingredient in functional foods. The rich diversity of phytochemicals present in *M. acuminata* plant parts may be responsible for health beneficial effects and justify their use against various diseases in traditional medicine. Some studies on animal models against selected pathological conditions provide evidence of the efficacy of the *M. acuminata* plant as a therapeutic agent

and acclaim the use of *M. acuminata* by various tribes and ethnic groups across the geographical boundaries of the world. *M. acuminata* plant parts have been consumed in varying quantities and forms by many populations across the globe over a long period, and no toxicity has been reported. However, the major edible part of *M. acuminata*; the fruits, which provides energy, vitamins, and minerals in good amounts are rarely consumed; and food application of other plant parts also is still unknown, which opens the door for the development of food products with potential health benefits from *M. acuminata*. *M. acuminata* has been traditionally used to treat various diseases and ailments such as fever, bronchitis, allergic reactions, sexually transmitted infections, and some non-communicable diseases. All parts of the plant including fruit, stem, pseudo stem, flower, leaf, sap, inner trunk, inner core, and root have found their use in traditional medicine. The compounds isolated from *M. acuminata* have been used as anti-hypertensive, anti-diabetic, anthelmintic, and anti-HIV; and have proven useful against tuberculosis and other respiratory diseases traditionally. *M. acuminata* has been used in anti-microbial gel formulations, and the curative effect of *M. acuminata* in combination with western medicine has been shown in a clinical study, however, the potential of some of the parts of this plant in disease prevention is not known, which needs further study. There are promising phytochemicals present in *M. acuminata*, such as (+)-6-methoxy- $\alpha$ -methyl-2-naphthaleneacetic acid anti-inflammatory activity, BanLec anti-HIV-1 activity, and others that show promising wound healing, anti-tuberculosis and Leishmanicidal activity, which needs to be taken to clinical trials for the possible development of drugs. Another bioactive constituents of *M. acuminata* also needs further investigations for validation of various pharmacological claims, and to explore their potential use in the development of drugs and as a functional food ingredient. Investigations are also required to characterize various phytochemicals present in *M. acuminata* that work individually or synergistically with other compounds or known drugs to provide the ameliorative or protective effects against various diseases.

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## Compliance with ethical standards

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### Disclosure of conflict of interest

The author declares no conflict of interest regarding publication of this article.

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### Authors short Biography



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