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# A REVIEW ON ETHNOPHARMACOLOGICAL ACTIVITIES OF MUSA PARADISIACA LINN

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**Abstract**

*Musa paradisica* Linn. (Plantain or cooking banana) is one of the main crops grown by farmers and is the primary source of sustenance for both animals and people in several regions of the world. It exhibits a number of advantageous traits. In traditional medicine, several human ailments are treated using both the fruits and other plant components such the stalk, peel, spathe, pulp, and leaf. Since ancient times, plants have been used in traditional medicine, and they provide a variety of biologically significant active metabolic products. Pharmaceutical businesses have recently shown a lot of interest in using these goods as an alternative to medications that are chemically synthesised. This is because studies on how individuals from many backgrounds use plants as a therapy and treatment for many ailments, as well as side effects of synthetic drugs, as well as the development of significant new medicines from plants. One of the valuable fruits with established pharmacological potentials is the banana, an edible fruit produced by various herbaceous flowering plants of the genus Musa. There are bananas practically everywhere in the world. In this article, we talk about the pharmacological properties of bananas, including their ability to treat atherosclerosis, treat ulcers, and fight cancer and other diseases.

**Keywords:** Musa paradisiaca, Pharmacological activity, Antidiabetic, Anti-ulcer, Anti-cancer

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## Introduction

*Musa paradisiaca* Linn. is a herbaceous flowering plant commonly known as plantain or cooking banana. Although originally from India and the rest of southern Asia, it is now cultivated across the whole sub- and tropical African continent, including in Nigeria. Plantains, of which Nigeria produces about 2.11 million metric tonnes annually, are a major staple food for many indigenous peoples living in the subtropics[1]. Bananas, with an estimated yield of 10 million per hectare, are widely recognised as one of the cheapest, most widely available, and healthful foods in the entire humid and temperate region of the planet. *Musa paradisiaca* is a member of the family Musaceae, which consists of the genera Musa, Ensete, and Musella. The genus Musa contains the most species (about 35), including the well-known *Musa acumiata*, *Musa balbisiana*, and *Musa sapietum*, among others. There are numerous classifications for Musa species. The most up-to-date DNA research classifies three subgroups: Musa (22 chromosomes), Callimusa (20 chromosomes), and Ingenti musa (14 chromosomes). Depending on the species and the soil conditions, *M. paradisiaca* can reach a height of 9 metres and produce a crop of moon-shaped fruits up to 7 centimetres in length[2]. *M. paradisiaca* relies on the wind to spread its seeds, which are carried aloft on blazing, long, slender spikes. When compared to other herbaceous plants, *M. paradisiaca* is the only one that thrives on soils that have been compacted. It grows in abundance next to paved walkways, roads, riverbanks, and other places with level ground. This plant occurs naturally both in savanna and as a weed in cropland. *M. paradisiaca* is a significant animal and human food source throughout South and Central America, Asia, and Africa due to its high starch

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content. More than 600 million people in Africa rely on *M. paradisiaca* for their daily calorie intake. There have been promising recent developments suggesting that plants may become a significant primary source of medications. Many individuals in Nigeria, a developing country, seek relief from their health problems by using herbs or other plant-based remedies. Maybe it's because people have started using herbs and other natural remedies instead of manufactured pharmaceuticals and expensive medical care. To name just a few examples, digoxin is derived from the plant *Digitalis lanata*, quinidine and quinine are derived from *Chinchona officinalis*, vinblastine and vincristine are derived from Catharanthus spp., atropineis derived from Atropa spp., and codeine and morphine are derived from Papaver spp. Numerous ethno pharmacological and ethno botanical investigations have been prompted by the therapeutic and economic importance of *M.paradisiaca*, leading to the discovery of several intriguing qualities of plant components[3]. These qualities of the plants are based mostly on the traditional therapeutic uses to which they have been put by indigenous peoples. The bioactive compounds and minerals found in *Musa paradisiaca* have been put to use in the treatment and management of a wide range of medical conditions. Unripe *M. paradisiaca* peels and fruits, for instance, shown anti-ulcerogenic activity when fermented, followed by extraction with water. Additionally, hydroxyl anigorufone isolated from *M. paradisiaca* showed promise as a cancer chemopreventive agent[4]. The methanolic extract of plantain inflorescence also included 12 polyphenols, and its dietary fibre content was measured at 12.54 percent. There was evidence that these polyphenols could help prevent diabetes and cardiovascular disease. After being recognised as a matrix, the dietary fibre found in plantain inflorescence holds biologically active chemicals[5]. Beneficial effects on GI health and reduced colon cancer risk result from the constant production of these biologically active compounds during digestion, thanks to the probiotic bacteria that aid in fermentation. In this article, we will attempt to summarise the many different nutritional benefits, pharmacological processes that have been attributed to *M. paradisiacal*[6].

**Pharmacological activities of *Musa paradisiaca***

**Antidiabetic activities of *Musa paradisiaca*:**

In mice given Musa paradisiaca fruit extracts, extracted in methanol, chlorpropamide, an anti-diabetic medication, was evaluated in both non-diabetic and Streptozocin-induced diabetic mice. In mice with diabetes and normal blood glucose levels, oral treatment of MEMP (100–800 mg/kg) significantly reduced blood glucose levels ($p<0.05$–$0.001$). Chlorpropamide (250 mg/kg p.o.) significantly reduced the blood glucose levels of both normal and diabetic mice ($p<0.01$ and $p<0.001$) [7]. The impact of anti-hyperglycemia was examined by After 30 days of oral administration of a chloroform extract of *Musa sapientum* flowers at doses of 0.15, 0.20, and 0.25 g/kg body weight, blood glucose and glycosylated haemoglobin were dramatically reduced, and total haemoglobin was significantly raised[8]. It is exceedingly risky to have either form of diabetes, which can be treated with or without insulin. Banana is one of many plants whose potential to reduce blood glucose levels in people with diabetes has been explored. The anti-hyperglycemic properties of the peels of Musa sapientum (EMS), *Musa paradisiaca* (EMP), Musa cavendish (EMC), and *Musa acuminata* (EMA) were examined using an oral glucose tolerance test in rats that had been normoglycemic (had normal glucose concentrations) and had been given a glucose load of 2 g/kg p.o. of glucose [9]. In this investigation, it was discovered that the anti-hyperglycemic effects of EMC (500 and 1000 mg/kg, p.o.) and EMA (200 and 400 mg/kg, p.o.) treatment were significantly significant ($p<0.01$). Both EMS (200 mg/kg, p.o.) and EMP (500 mg/kg, p.o.) caused a decrease in blood sugar levels ($p<0.01$) [9]. A different study evaluated the in vitro antidiabetic activity of methanol extracts of three distinct fruit peels (lemon, pomegranate, and banana), and found that banana peel had the strongest alpha amylase inhibitory efficacy (80.87 percent at 1000 g/mL). Banana peel therefore has the highest hypoglycemic effect of the three [10]. As a result, it can be used as a substitute for the vitamin antidiabetic [9]. The hypoglycemic effects of a methanolic extract of mature green fruits of M. paradisiaca were examined in normal (normoglycemic) and streptozotocin-induced diabetic (hyperglycemic) mice [11]. The extract was discovered to have a hypoglycemic effect, which provides experimental support for the plant's traditional use in the treatment of type-2 diabetes mellitus [12].

The scientific basis for using plantains in traditional diabetes treatment has to be looked into because diabetes is a major global burden and is particularly bad in Africa, where health services are already under a lot of strain [13]. Aqueous extracts and methanolic fractions of M. paradisiaca flowers and bracts significantly

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lowered blood sugar levels in male Wistar rats that had diabetes brought on by intravenous streptozotocin (STZ) [14]. The methanolic fractions of the flower had the largest impact on glucose tolerance after 15 days of therapy, although the aqueous extract of the bract had effects that were quite similar to those of insulin therapy [15]. However, all of the extracts and fractions indicated improvement in contrast to the untreated control group due to the presence of flavonol glycoside and anthocyanins in the fractions and extracts, each of which has been shown to contain anti-hyperglycaemic activity. This study supports the idea that inflorescence could be investigated as a potential functional food and/or nutraceutical with excellent nutritional and organoleptic properties [16]. This study validates the antidiabetic activity of methanolic flower extract due to the polyphenolic compound and dietary fibres present. Because aqueous extracts are simpler to obtain than methanolic fractions, the authors advise using them instead of the methanolic fraction [17].

For instance, according to research by Shodehinde et al., the polyphenolic content of the unripe pulp of M. paradisiaca reduced blood glucose levels in experimentally diabetic adult male Wistar rats by inhibiting intestinal glucosidase, pancreatic amylase, and angiotensin-I-converting enzyme (ACE) after 14 days of oral administration [18]. In experimentally diabetic rats, diabetes indices were recovered after 30 days of oral administration of syringin (50 mg/kg body weight), which is derived from the ethanolic extract of plantain flowers. Syringin, a phenyl-propanoid glucoside with the chemical formula 4-[(1E)-3-hydroxyprop-1-en-1-yl, is thought to possess antibacterial effects. 2, 6-dimethoxyphenyl-D-glucopyranoside acts to maintain glucose and C-peptide homeostasis. A plantain-based diet combined with chemotherapy may help manage the condition, but any potential interactions must be considered. Dietary therapy using plantain-based dough meals supplemented with cassava fibre and soybean cake has been shown to lower blood glucose levels. It has been proposed that the high micronutrient content of plantains is what causes this effect because potassium and salt are so crucial to metabolism, bodily fluids, and the composition of structural tissues [19].

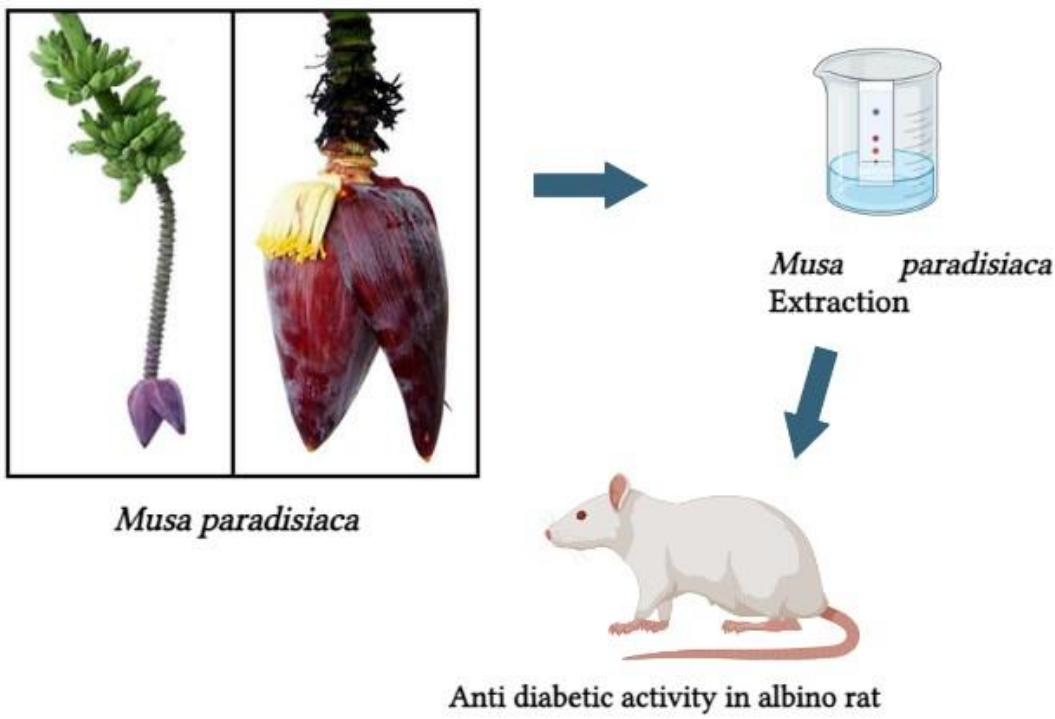


**Figure 1.** *Musa paradisiaca* Diabetic activity

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**Anti-ulcer activity of *Musa paradisiaca***

Banana is a common ingredient in herbal remedies for gastric ulcers. M. sapientum has been studied and proven to be useful in the treatment of peptic ulcers as a herbal supplement. It has been stated that the stomach mucosa protective function of the banana is attributed to a number of active components, including the pectin and phosphatidylcholine found in green bananas, which reinforce the mucous phospholipid layer that protects the gastric mucosa [20]. Leucocyanidin, a natural flavonoid found in the pulp of unripe bananas (M. sapientum var. paradisiaca), helps to prevent erosions of the gastrointestinal mucosa. Gastric mucosa was reported to be protected by leucocyanidin and its synthetic counterparts, hydroxyethylated leucocyanidin and tetraallyl leucocyanidin, in aspirin-induced erosions in rats [21]. When tested on rats and guinea pigs with gastric ulcers caused by aspirin, indomethacin, phenylbutazone, and prednisolone, as well as duodenal ulcers induced by cysteamine and histamine, banana pulp powder (M. Sapientumvar. paradisiaca) demonstrated considerable antiulcerogenic efficacy, as described by Goelet et al. (1986). The authors hypothesised that this was due to an increase in mucosal thickness and [3H] thymidine incorporation into mucosal DNA, both of which promote mucosal cellular proliferation and repair. Oral administration of banana pulp powder as an aqueous suspension at a dose of 0.5 g/kg twice daily for 3 days produced the same results in rats as reported by Goel et al., (1986). They also noted a marked decline in the amount of DNA found in stomach juice following therapy. According to a 2001 study by Pannangpetchet et al., the antiulcerative efficacy of bananas may differ between cultivars. Both M. sapientum and M. paradisiaca ethanolic extracts were shown to have a considerable gastroprotective effect, but only M. paradisiaca promoted ulcer healing by a mechanism similar to that of prostaglandins [22]. Ash from M. sapientum fruit peel has been shown to have acid neutralising properties in rats, according to a study by Jainet al., 2007.

The antiulcer effect of the siddha medicine ripe fruit Musa paradisiaca bhasma was investigated by Elango et al. in rats with an acute ulcer model induced by ethanol (80%) and a chronic ulcer model induced by acetic acid. Both 10 and 20 mg/kg of bhasma were orally provided to the animals 1 hour before the formation of ulcers in the acute model, and the same dosage was given once daily for 10 days in the chronic type. A drop in the ulcer index and an increase in mucin content both point to the bhasma's efficacy as an antiulcer agent [23]. Lipid peroxidation, catalase, and superoxide dismutase levels were also found to be significantly decreased, indicating strong antioxidant activity. Musa paradisiaca methanol extract was studied for its cytoprotective effects against indomethacin-induced peptic ulcer in conjunction with catecholamines by Herbert et al. The extract was tested for its cytoprotective and anti-secretory effects using the pylorus ligation method. According to the findings, Musa paradisiaca methanolic extract has cytoprotective action against indomethacin-induced ulceration [24].

**Antihypertensive Activity**

High blood pressure is a physiological condition known as hypertension (35). Stroke, heart attack, and heart failure are only few of the CVD that have been linked to long-term hypertension. Similarly, oxidative stress-induced cardiac inflammation is a primary contributor to cardiovascular disease [25]. In the pathophysiology of cardiovascular diseases such congestive heart failure (CHF), hypertension, and heart attack, the renin-angiotensin system (RAS) plays a crucial role in the regulation of fluid balance, blood pressure (BP), and salt. From angiotensinogen, renin creates angiotensin-I, which is transformed by angiotensin-I converting enzyme (ACE) into angiotensin-II, a powerful vasoconstrictor. There is a lack of data on whether the peels (unripe, ripe, and over-ripe) constituting a waste problem may exert anti-hypertensive property, but M. paradisiaca have reportedly been used in folkmedicine for the management or prevention of hypertension [26]. Characterising the interaction of the aqueous extract of the peels with ACE, which is thought to be effective in therapeutic strategy for management or treatment of high BP, allowed us to assess the extracts' antihypertensive potential. The reported therapeutic benefits of the peels may have been enhanced by the significant inhibitory effects of the water-extractable phytochemicals [27]. In addition, the hypotensive effects of ripe banana pulp (50 gm/rat/day) were tested in rats whose blood pressure was artificially raised by deoxycorticosterone enanthate (DOC,25 mg/rat). The high tryptophan and carbohydrate content of ripe banana pulp causes an increase in serotonin levels, which in turn mediates natriuretic effects. The impact of plantain aqueous extract was also documented by Orie, who found that it had a concentration-dependent hypotensive (CDH) effect on rat aortic rings and portal veins that had been contracted with

norepinephrine and potassium chloride (KCl). After this is accomplished, M. paradisiaca could be used in the creation of hypertension management and/or preventive nutraceuticals [28].

The effects of plantains on the mean arterial blood pressure of albino rats treated with deoxy-corticosterone acetate (DOCA) have been studied. A plantain-based meal brought the mean arterial blood pressure of DOCA-treated rats down to normal values. In addition, DOCA-treated rats whose diets included plantain did not exhibit any clinically significant changes in arterial BP compared to controls. Plantain consumption has been shown to attenuate DOCA-induced hypertension in rats and to postpone its onset in those animals [29].

**Anticancer Activity shown by *Musa paradisiaca***

According to a study by Vijayakumar et al., gold nanoparticles synthesised using plantain peel aqueous extract significantly suppressed in vitro A549 lung cancer cells at a concentration between 25 and 100 µg/mL compared to DMSO, saline, peel extract, and HAuCl4. The apoptotic route was hypothesised to be responsible for the cytotoxic activity, and the IC50 was calculated to be 58 µg/mL. Traditional treatments for cancer and related inflammatory disorders often involve the use of M. paradisiaca, and our study lends scientific credibility to that practice [30].American Type Culture Collection (ATCC, Rockville, MD) strains of hepatocellular (HepG-2) and human colon (HCT-116) carcinomas have been demonstrated to be inhibited by plantain pseudostem exudates, which constitute roughly 31% of the plant mass. HepG-2 carcinoma was the most sensitive, with an IC50 of 29.4 µL and the maximum cytotoxic effect on the cell lines at 100 L [31].As a related activity, the exudate of plantain pseudostem induced protective action against free radicals at a concentration-dependent rate (IC50 = 2.2 µL) as measured by the DPPH scavenging experiment [32]. This finding indicates that the extract of the pseudostem, which contains tannins and polyphenols, can act as a prooxidant and antioxidant. Antioxidants such as gallocatechin, dopamine, gentisic acid, cinnamic acid, protocatechuic acid, ferulic acid, and caffeic acid have been reported in M. paradisiaca's peels, pseudostem, gallic acid, syringic acid, -coumaric acid, and ferulic acid, and catechol in the inflorescence. Antioxidant effects are known to lessen the risk of cardiovascular disease, degenerative disease, and cancer, in addition to mitigating illnesses caused by reactive oxygen species. This provides a preliminary rationale for investigating M. paradisiaca for bioactive compounds [33].

**Anti-microbial Activity of *Musa paradisiaca***

Some banana species, particularly Musa paradisiaca, have had their leaf extracts studied for their antibacterial properties. E. coli, P. aeruginosa, Citrobacter species, and other bacteria linked to hospital-acquired infections were utilised as test organisms to determine their antibacterial activity [34]. Based on the results of the study, ethyl acetate extracts are more effective than methanolic extracts, which are superior to hexane extracts. However, the effectiveness of ethyl acetate extracts differed from that of chloramphenicol [35]. Hexane extracts failed to kill off P. mirabilis and E. aerogenes. The MIC values for the various solvent extracts were as follows: hexane, 125.00–250.00 g/mL; methanolic, 15.63–250.00 g/mL; ethyl acetate, last, 156.3–125.00 g/mL. The bactericidal concentration ranged from 31.25 g/mL in ethyl acetate and methanolic extracts to 250.00 g/mL in hexane extract. The main pattern of bactericidal concentration was as follows: Escherichia coli < Pseudomonas aeruginosa <Enterobacter aerogenes < Klebsiella pneumoniae < Shigella flexneri < Citrobacter sp. < Enterococcus faecalis < Staphylococcus aureus. The authors conclude that the presence of phenolic compounds is responsible for the observed activity, a conclusion supported by the data on the antioxidant activity of these compounds. Antioxidant activity was highest in M. paradisiaca, followed by M. acuminata, M. sapientum, and M. troglodytarum. The sole caveat of this research is that a toxicity investigation would be needed to prove safety because certain extracts required rather high concentrations to achieve inhibitory or bactericidal action [36]. The acute toxicity LD50 recorded by Asuquo and Udobi was 489.9 mg/kg for ethanolic extract, indicating that an effective dose may be harmful. Similar results were found in a research conducted by Amutha and Selvakumari, who reported a MIC of 0.5 mg/mL for P. aeruginosa and 1.0 mg/mL for S. aureus, with an inhibition zone (mm) that ranked third for P. aeruginosa after gentamicin and second for S. aureus after chloramphenicol and novobiocin.

Using the agar well disc diffusion method, Karadi et al. found that an extract of M. paradisiaca fruit peels in a dichloromethane and methanol (1:1) mixture was antibacterial against

Escherichia coli, Staphylococcus aureus, Bacillus subtilis, Pseudomonas aeruginosa, Candida albicans, Candida tropicalis, and A. niger. The test isolates were more vulnerable to the M. paradisiaca extract than the Cocos nucifera one, according to the results [37].
Okorondu et al. tested the effectiveness of methanolic and ethanolic extracts of plantain peel and stalk against Aspergillus niger, Aspergillus oryzae, and Rhizopus stolonifer at various doses (1.00, 0.50, 0.25, 0.125, 0.0625 mg/mL). After A. niger and A. oryzae, R. stolonifer showed the most sensitivity to the extracts from the peel and stalk. The activity of the methanolic extracts was higher than that of the ethanolic extract [38]. The MICs for A. niger were 0.125 mg/mL, 0.25 mg/mL, and 0.5 mg/mL for both ethanol and methanol, whereas the MICs for A. oryzae and R. stolonifera were 0.5 mg/mL and 125 mg/mL, respectively [39]. The methanolic minimum inhibitory concentration (MIC) for A. niger and A. oryzae was 0.25 mg/mL, while the MIC for R. stolonifera was 0.125 mg/mL, showing a distinct trend. The MICs for A. niger were 0.0625 mg/mL, A. oryzae was 0.125 mg/mL, and R. stolonifera was 0.25 mg/mL. All of the isolates had a MIC of 0.25 mg/mL for ethanolic extracts [40].

***Musa paradisiaca* wound healing Activity**

As a result of its primary effects on mucosal defence factor, which boosts DNA synthesis and increases mucosal cell proliferation, banana peel has been credited with wound healing activity. Plantain banana (Musa sapientum var. paradisiaca) methanol and water extracts were tested for their ability to promote wound healing in rats. Both extracts improved wound tensile strength and elevated levels of hydroxyproline, hexuronic acid, hexosamine, and superoxide dismutase. Lipid peroxidation and wound/scar sizes were also reduced by the extracts. The plantain's antioxidant properties were blamed for these outcomes [41].
Amutha and Selvakumari used a red hot steel rod to make a burn wound above the hind limb region of wistar albino rats, and then observed the wound's progress towards healing every day while they applied a methanolic extract of Musa paradisiaca Linn. stem to it. Histopathological analysis was used to determine the pace of wound contraction [42]. Musa paradisiaca Linn. methanol extract was found to have more curative activity than the control in Wistar albino rats.

**Atherosclerosis activities**

The formation of plaque inside the arteries is the hallmark of atherosclerosis, an arterial disease. Ambon (*Musa paradisiaca*) peel was employed in an immunohistochemistry investigation on atherogenic rats to determine whether or not it acts as an anti-atherosclerotic agent by inhibiting NF-kappa B and boosting endothelial nitric oxide synthase expression. In a dose-dependent way, the extract was found to reduce NF- activity while simultaneously increasing e-NOS activity. The extract has been shown to reduce NF- activity by 82.1% by linear regression analysis, while simultaneously increasing e-NOS expression by around 95.2%. As a result, it is clear that the use of banana peel extract from the island of Ambon can help reduce the risk of atherosclerosis. This finding demonstrated that the peel extract is helpful in preventing atherosclerosis by slowing the atherosclerotic process by decreasing the expression of chemo-attractant molecules and monocyte adherence. In a similar vein, looked at how the Kepok banana peel compounds saponin, tannin, and flavonoid affected total cholesterol level in obese male mice. Twenty obese male mice (Mus musculus L.) were randomly assigned to one of four treatment groups and observed for 14 days. Spectrophotometer readings revealed the groups' respective total cholesterol levels [43]. Researchers found that giving rats either 8.4 or 16.8 milligrammes per day of an extract from the Kepok banana peel reduced their overall cholesterol levels. The anti-atherosclerotic action of banana peel extract was confirmed by its ability to reduce total cholesterol levels in obese mice. Based on the conversion of the effective doses of banana peel extract for rats, the researchers obtained 8.4 and 16.8 mg/day. The total cholesterol level in rats can be lowered by 200 mg/kg by administering banana peel extract.
The potential impact on atherosclerotic plaque and gallstones in vivo was reported by Saraswathi and Gnanam, who found that M. paradisiaca prevents cholesterol crystallisation in vitro. The peel extract of M. paradisiaca was studied by Parmar and Kar in rats with diet-induced atherosclerosis. Although not as effective as other plants studied, this study reports the extract's preventive impact in atherosclerosis and thyroid dysfunction. Additional research conducted by Yin et al. (2008) on the effects of bananas on humans revealed that even after only one banana meal, plasma oxidative stress was dramatically reduced and resistance to oxidative modification

of LDL was improved[44]. Bananas may have this impact because they contain dopamine, ascorbic acid, and other antioxidants.

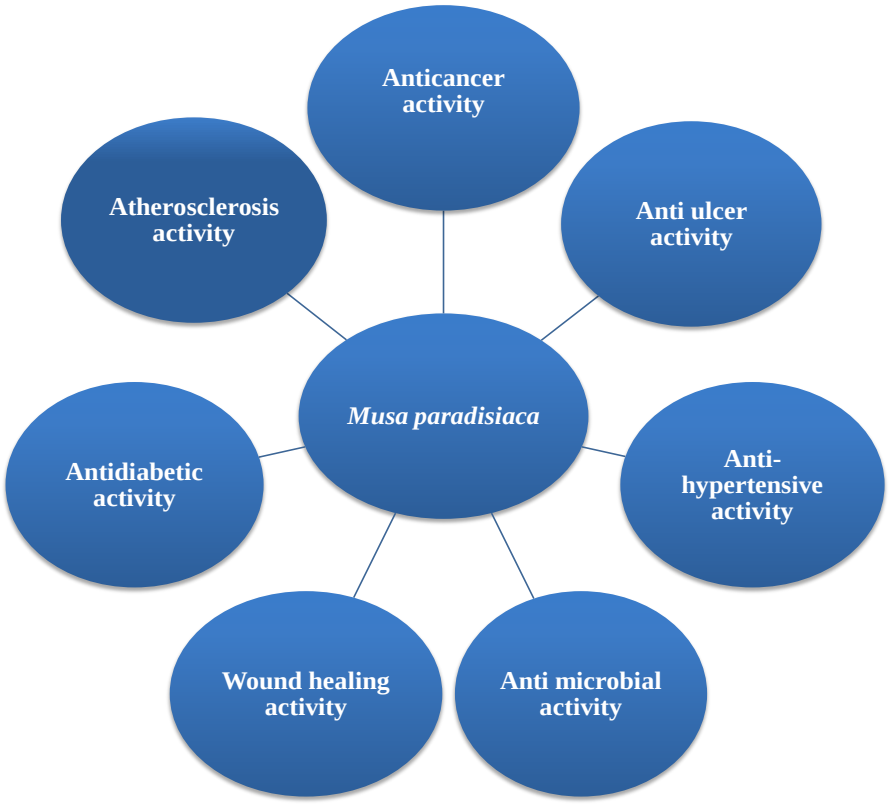


**Figure 2.** Different Pharmacological activity of *Musa paradisiacal*

## Conclusion

Bananas have both nutritional and therapeutic value, making them a staple diet in many parts of the world. Because of their unique bioactive secondary metabolites, they are highly sought for. The pharmacological properties of Musa paradisiaca are discussed in depth in this article. Traditional applications of the plant in the treatment of diabetes, ulcers, cancer, high blood pressure, atherosclerosis, and wounds have been supported by a review of pharmacological research. Modality, quality control, efficacy, safety, and toxicity are only some of the preclinical and clinical concerns that need to be addressed to get there. Finally, ethnopharmacological studies will give the appropriate support needed for clinical usage of secondary metabolites of banana species in contemporary medicine by examining the genetic diversity of banana species and its adaptation to varied environmental situations. The active components in various extracts of banana sections also need to be determined, which requires extensive phytochemical screening. As opposed to the existing dependence on empirical and anecdotal assumptions, this will enrich the literature and give a strong platform for scientific reasoning.

## References

1. Abd Ghafar SA, Hasan Fikri I, Eshak Z (2019) Antioxidant activity of *Musa paradisiaca* (banana) soft pith and its cytotoxicity against oral squamous carcinoma cell lines. Malays J Med Health Sci 3:8–11
2. Abdel Ghany TM, Ganash M, Alawlaqi MM, Al-Rajhi AMH (2019) Antioxidant,

antitumor, antimicrobial activities evaluation of *Musa paradisiaca* L. pseudostem exudate cultivated in Saudi Arabia. BioNanoScience 9:172–178. https://doi.org/10.1007/s12668-018-0580-x

3. Adelekan EO, Adegunwa MO, Adebowale AA, Bakare HA, Alamu EO (2019) Quality evaluation of snack produced from black pepper (*Piper nigrum* L.), plantain (*Musa paradisiaca* L.), and tigernut (*Cyperus esculentus* L.) flour blends. Cogent Food Agric 5:1614285
4. Adeolu A, Enesi D (2013) Assessment of proximate, mineral, vitamin and phytochemical compositions of plantain (*Musa paradisiaca*) bract—an agricultural waste. Int J Plant Sci 4:192–197
5. Ahmad BA, Mohd KS, Abdurrazak M, Rao UM, Zin T (2015) Phytochemical screening, antioxidant activity of pure syringin in comparison to various solvents extracts of *Musa paradisiaca* (banana) (fruit and flower) and total phenolic contents. Int J Pharm Pharm Sci 7:242–247
6. Akinsanmi AO, Oboh G, Akinyemi JA, Adefegha AS (2015) Assessment of the nutritional, anti nutritional and antioxidant capacity of unripe, ripe and over ripe plantain (*Musa paradisiaca*) peels. J Adv Res 3:63–72
7. Ojewole JA and Adewunmi CO. Methods Find Exp Clin Pharmacol. 2003; 26(6):453-26.
8. Orie NN. Exp Physiol. 82(3); 1997:501-64.
9. Pari L and Umamaheswari J. Antihyperglycaemic activity of Musa sapientum flowers: effect on lipid peroxidationin alloxan diabetic rats. Phytother Res, 14(2); 2000: 136-8.
10. Navghare VV, Dhawale SC. In vitro antioxidant, hypoglycemic and oral glucose tolerance test of banana peels. Alexandria Journal of Medicine. 2017; 53: 237-243. DOI: 10.1016/j.ajme.2016.05.003
11. Pooja V, Nazia DK, Zia HK, Mular SM. In vitro antidiabetic activity of methanolic extract of Citrus limon, Punica granatum, Musa acuminata peel. International Journal of Applied Research. 2017; 3(4):804-806. Available from: www.allresearchjournal.com
12. Ojewole JA, Adewunmi CO. Hypoglycemic effect of methanolic extract of Musa paradisiaca (Musaceae) green fruits in normal and diabetic mice. Methods and Findings in Experimental and Clinical Pharmacology. 2003;25(6):453-456
13. Meigs JB (2019) The genetic epidemiology of type 2 diabetes: opportunities for health translation. Curr Diab Rep 19:62. https://doi.org/10.1007/s11892-019-1173-y
14. Tekola-Ayele F, Adeyemo AA, Rotimi CN (2013) Genetic epidemiology of type 2 diabetes and cardiovascular diseases in Africa. Prog Cardiovasc Dis 56:251–260. https://doi.org/10.1016/j.pcad.2013.09.013
15. Vilhena RO et al (2020) Antidiabetic activity of Musa x paradisiaca extracts in streptozotocin-induced diabetic rats and chemical characterization by HPLC-DAD-MS. J Ethnopharmacol 254:112666. https://doi.org/10.1016/j.jep.2020.112666
16. Ajiboye BO, Oloyede HOB, Salawu MO (2018) Antihyperglycemic and antidyslipidemic activity of Musa paradisiaca-based diet in alloxan-induced diabetic rats. Food Sci Nutr 6:137–145. https://doi.org/10.1002/fsn3.538
17. Adelekan EO, Adegunwa MO, Adebowale AA, Bakare HA, Alamu EO (2019) Quality evaluation of snack produced from black pepper (Piper nigrum L.), plantain (Musa paradisiaca L.), and tigernut (Cyperus esculentus L.) flour blends. Cogent Food Agric 5:1614285
18. Shodehinde SA, Oboh G (2013) Antioxidant properties of aqueous extracts of unripe Musa paradisiaca on sodium nitroprusside induced lipid peroxidation in rat pancreas in vitro. Asian Pac J Trop Biomed 3:449–457. https://doi.org/10.1016/S2221-1691(13)60095-7
19. Salau. Methanolic Extract of Musa sapientum Sucker Moderates Fasting Blood Glucose and Body Weight of Alloxan Induced Diabetic Rats. Asian J. Exp. Biol. Sci., 2010; 1(1): 30-35.
20. Goel et al., Anti-Ulcerogenic Effect of Banana Powder (Musa sapientum var. paradisiaca) and Its Effect on Mucosal Resistance. J. Ethnopharmacol.18; 1986:33-44.
21. Dunjićet al., Green banana protection of gastric mucosa against experimentally induced injuries in rats. A multicomponent mechanism? Scand. J. Gastroenterol. 28(10); 1993:894-598

22. Elango, K., Subburaj, T., Suresh, B., Ramesh, B. R., & Vadivelan R. (2007). Gastroprotective and antioxidant effects of siddha drug (Musa paradisiaca Bhasma) on experimentally induced gastric ulcers in rats. Journal of Research and Education in Indian Medicine, 13(1), 63-69. 41.
23. Herbert, B. E., Joyce, O. O., Chukwudum, K. A., & Onuebunwa C. L. (2013). Cytoprotective Effects of Musa Paradisiaca and in combination with catecholamines on Indomethacin-induced peptic ulceration in rats. American Journal of Pharm Tech Research, 3(4), 702-711.
24. Vadivelan R, Elango K, Suresh B, Ramesh BR (2006) Pharmacological validation of Musa paradisiaca Bhasma for antiulcer activity in albino rats—a preliminary study. Anc Sci Life 25:67–70
25. World Health Organization. World Health Day Campaign 2013: Silent Killer, a global public health crisis. Retrieved 2014March 14. Available from: http/www.who.int/campaign?worldhealth/ 2013/en/index.index.html
26. James RS, Murray E, Edward DF. Diabetes, hypertension, andcardiovascular disease an update. 2001;37:1053-59.https://doi.org/10.1161/01.HYP.37.4.1053
27. Martinon F. Signaling by ROS drives inflammasome activation. European journal of immunology. 2010;40:616-19.https://doi.org/10.3389/fimmu.2021.732127
28. Steven A. The renin-angiotensin-aldosterone system: pathophysiological role and pharmacologic inhibition. Journalof Managed Care Pharmacy. 2007;13:S9.https://doi.org/10.18553/jmcp.2007.13.s8-b.939
29. Shin J, Rabinovitch M. Hypertension in Rats. 2014;87 131 (1):1-14.
30. Vijayakumar S et al (2017) Therapeutic effects of gold nanoparticles synthesized using Musa paradisiaca peel extract against multiple antibiotic resistant Enterococcus faecalis biofilms and human lung cancer cells (A549). Microb Pathog 102:173–183. https://doi.org/10.1016/j.micpath.2016.11.029
31. Correa M, Mesomo MC, Pianoski KE, Torres YR, Corazza ML (2016) Extraction of inflorescences of Musa paradisiaca L. using supercritical CO2 and compressed propane. J Supercrit Fluids 113:128–135
32. Nadumane VK, Timsina B (2014) Anti-cancer potential of banana flower extract: an in vitro study. Bangladesh J Pharmacol 9:628–635
33. Aune D et al (2017) Fruit and vegetable intake and the risk of cardiovascular disease, total cancer and all-cause mortality-a systematic review and dose-response meta-analysis of prospective studies. Int J Epidemiol 46:1029–1056. https://doi.org/10.1093/ije/dyw319
34. Abdel Ghany TM, Ganash M, Alawlaqi MM, Al-Rajhi AMH (2019) Antioxidant, antitumor, antimicrobial activities evaluation of Musa paradisiaca L. pseudostem exudate cultivated in Saudi Arabia. BioNanoScience 9:172–178. https://doi.org/10.1007/s12668-018-0580-x
35. Asoso O, Akharaiyi FC, Animba L (2016) Antibacterial activities of plantain (Musa paradisiaca) peel and fruit. Der Pharm Lett 8:5–11
36. Bagavan A, Rahuman AA, Kaushik NK, Sahal D (2011) In vitro antimalarial activity of medicinal plant extracts against Plasmodium falciparum. Parasitol Res 108:15–22
37. Chabuck ZAG, Al-Charrakh AH, Hindi NKK, Hindi SKK (2013) Antimicrobial effect of aqueous banana peel extract. Iraq Res Gate Pharm Sci 1:73–75
38. Jawla S, Kumar Y, Khan M (2012) Antimicrobial and antihyperglycemic activities of Musa paradisiaca flowers. Asian Pac J Trop Biomed 2:S914–S918
39. Kapadia SP, Pudakalkatti PS, Shivanaikar S (2015) Detection of antimicrobial activity of banana peel (Musa paradisiaca L.) on Porphyromonas gingivalis and Aggregatibacter actinomycetemcomitans: an in vitro study. Contemp Clin Dent 6:496–499.
40. Karadi R, Shah A, Parekh P, Azmi P (2011) Antimicrobial activities of Musa paradisiaca and Cocos nucifera. Int J Pharm 2:264–267
41. Amutha, K., & Selvakumari, U. (2016). Wound healing activity of methanolic stem extract of Musa paradisiaca Linn. (Banana) in wistar albino rats. International Wound Journal, 13(5), 763-767
42. Agarwal PK, Singh A, Gaurav K, Goel S, Khanna HD, Goel RK. Evaluation of wound healing activity of extracts of plantain banana (Musa sapientum Var.

paradisiaca) in rats. Indian Journal of Experimental Biology. 2009;47:32-40

43. Arlinda SP, Kartika PR, Eria NP, Dyah PA, Wafiyah H. The effectiveness of Ambon banana peel extract (Musa sapientum) as atherosclerosis prevention through inhibition of NF-κβ and increased e-NOS expression in atherogenic rat model. International Journal of Medical Research and Health Sciences. 2017; 6 (9):114-120.
44. Berawi KN, Bimandama MA. The effect of giving extract etanol of Kepok banana peel (Musa acuminata) toward total cholesterol level on male mice (Mus musculus L.) strain Deutschland-denken-yoken (ddy) obese. Biomedical and Pharmacology Journal. 2018; 11 (2):769-774. DOI: 10.13005/bpj/1431