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Review Article

AN OVERVIEW ON PHARMACOLOGICAL ACTIVITIES OF *MUSA SAPIENTUM* AND *MUSA PARADISIACA*

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Abstract

Banana plant (*Musa sapientum*, *Musa paradisiaca*) is a herb, in the genus *Musa*. It is cultivated mainly for its fruit. The plants are mostly large perennial herbs with rhizomes, with stout and unbranched stem. Leaves are simple large with stem clasping sheaths. The fruit is a woody capsule or leathery or fleshy soft berry. The fruit average 125 gm, of which approximately 75% is water and 25% dry matter content. Bananas are valuable source of vitamin A, vitamin C and potassium. The plant is reported to have antiulcerogenic, antilithiatic, antimicrobial, analgesic, antihypertensive, antidiarrhoeal, antiallergic, antioxidant, diuretic, hypolipidemic, hypoglycaemic, hair growth promoting, haemostatic, muscle relaxant, mutagenic, wound healing and vasodilatory activities. A vast majority of our population depend largely on herbal medicines. This review gives an overview mainly on the medicinal uses, phytochemistry and pharmacological actions of banana plant.

Keywords: *Musa sapientum*, *Musa paradisiaca*, pharmacological activity, plantain banana.

The importance of traditional system of medicine and of certain traditional medical practices has now been recognized all over the world [1]. That human beings are still dependent on nature for remedies is well apparent from the fact that all the major systems of medicine e.g. Ayurveda, Unani and Homeopathy are largely based on drugs of plant origin [2]. Exploring traditional herbal medicines in the context of modern science is the need for optimum and proper utilization of traditional plant drugs. In the past decade WHO (recognizing the importance of herbal medicine) has passed many resolutions for improving the quality and efficacy of plant drugs [3]. *Musa sapientum* and *Musa paradisiaca* belong to the family *Musaceae*. The plants are giant herbs with 'false aerial stems and sheathed leaves arising from a rhizome. Fruit is berry [4]. It is cultivated throughout India [5].

Different parts of the banana plant are used for various traditional medicinal purposes. Roots and stems are used as tonic, antiscorbutic, useful in blood and venereal diseases. Unripe fruit, in combination with other drugs used in diabetes. Juice of flowers mixed with curds used in dysentery and menorrhagia. Young leaves are used as a cool dressing for blisters and burns [5]. Apart from traditional uses, there are several reports on important pharmacological activities of banana plant.

Taxonomical Hierarchy

Kingdom	:	<i>Plantae</i> .
Sub Kingdom	:	<i>Tracheobionta</i> .
Super Division	:	<i>Spermatophyta</i> .
Class	:	<i>Liliopsida</i> .
Sub Class	:	<i>Zingiberidae</i> .
Order	:	<i>Zingiberales</i> .
Family	:	<i>Musaceae</i> .

Genus : *Musa*. entire and simple. They are often pinnatifid and
 Species : *Musa sapientum*, grow from an underground rhizome. The leaf
Musa paradisiaca Linn. sheaths form a hollow false trunk [8].

Vernacular Names

Musa sapientum

English : Banana
 Hindi : Kela
 Assamese : Kol
 Bengali : Kola
 Oriya : Champa Kadali
 Marathi : Kele
 Gujarati : Kela / Kelu
 Tamil : Vazhai Kizhangu
 Telugu : Arati Pandu
 Kannada : Bale Hannu

Musa paradisiaca

Hindi, Punjabi : Kela (hara)
 Assamese : Kaskol
 Bengali : Kola (Kanch)
 Gujarati : Kela
 Kannada : Bale kayi
 Malayalam : Vazhakkai
 Tamil : Vazhakkai
 Marathi : Kele
 Oriya : Bantala kadali
 Telugu : Arati kayi

Distribution

The plant is widely distributed throughout India for its nutritious and delicious fruit [6].

Morphology

The plants are mostly large perennial herbs with rhizomes with stout and unbranched stem. Leaves are simple large with stem clasping sheaths. The fruit is a woody capsule or leathery or fleshy soft berry. Flowers are bisexual [7].

Flower: The inflorescence, growing through the false trunk and curving downward, bears groups of androgynous flowers beneath and finally female flowers. There are five stamens and a superior ovary [8].

Fruit: The fruit is berry. The 10-16 single fruits that develop from the flowers of a bract are called a hand [8].

Leaves, Stem, Root: The herbaceous perennial grows upto 6m height. The leaves are very large,

Parts used: Fruit, leaves and stems [6].

Phytochemical Constituents

The growing parts of the plant contain tannic and gallic acid. The ripe fruit contains 22% of sugar; starch, albuminoids 4.8%, fats upto 1%, and non nitrogenous extractives 6 to 13%. There are large quantities of vitamin C and a certain amount of vitamin B in it [6].

Leucocyanidin is a flavonoid isolated from unripe banana [9]. Minerals present in the fruit are magnesium, iron, potassium, zinc, copper, phosphorus, aluminium, sodium, nitrogen, and manganese [10]. The fruit is found to be very rich in micro and macro nutrients. Phosphorus and manganese are found to be more highly concentrated in the ripe fruit, whereas the unripe fruit contains high amount of calcium and selenium. Aspartic acid, glutamic acid and leucine are the major amino acids in the ripe fruit [11]. The fruit contains an acylsteryl glycoside, sitoindoside IV [12]. The ash of the husk of the ripe fruit contains carbonates of potash and soda, chloride of potassium alkaline phosphates, lime silica. Green plantain contains a large amount of tannin. Composition of the juice of the flower stem of the plantain is potash, soda, lime, magnesia, alumina, chlorides, sulphuric anhydride, phosphoric anhydride, silica and carbon anhydride [6].

Pharmacological Actions

Antiulcerogenic Activity: In a study conducted to evaluate the effect of orally administered banana pulp powder (0.5 mg/kg orally twice daily for 3 days) in ulcers induced by aspirin, indomethacin, phenylbutazone, prednisolone and cysteamine in albino rats and histamine in guinea pigs suggest that banana powder treatment not only strengthens mucosal resistance against the ulcerogens but also promotes healing by cellular proliferation [13].

In another study, albino rats fed with banana pulp 0.5 gm/kg orally twice daily for 3 days

showed significant increase in total carbohydrate content of gastric mucosa, significant decrease in gastric juice and protein and a significant increase in the total carbohydrate and carbohydrate protein ratio of gastric juice [14].

A study to evaluate the effect of the ethanolic extract of unripe banana on accumulation of eicosanoids in incubates of human gastric and colonic mucosa showed that it caused a concentration dependent increase in the eicosanoid accumulation. Since all the eicosanoids studied tended to increase, banana may act by increasing the availability of arachidonate [15].

The active ingredient of banana responsible for antiulcerogenic effect, identified to be leucocyanidin, a flavonoid. The leucocyanidin at 5 mg/kg orally demonstrated a significant ($p < 0.05$) protective effect against aspirin induced erosions [9].

Antilithiatic Activity: In a study, stem juice at 3ml/rat/day orally was found to be effective in reducing the formation and also in dissolving preformed stones in albino rats, which were implanted with zinc discs in the urinary bladder to induce urolithiasis [16].

In a clinical trial, the juice of *Musa pseudo-stem* formulated into tablets was administered for 4 or more weeks to 71 patients with urolithiasis. 43 patients passed out varying number of calcium oxalate calculi, while no calculi were detected in 20. When put on a prophylactic dose no recurrence of urolithiasis was observed in these patients over a period of 14 weeks [17].

Antimicrobial Activity: In a study conducted to evaluate the in-vitro antimicrobial activity of the root extracts of plantain banana, it was found that the benzene extract showed significant bactericidal and fungicidal effect. The hexane extract showed significant activity against gram negative bacteria [18].

In one study banana showed activity against *E. coli* and *Staphylococcus aureus* [19]. In another study the methanolic extract of *Musa paradisiaca* fruit peel showed significant activity against *Bacillus subtilis*, *Staphylococcus aureus*,

E. coli, *Pseudomonas aeruginosa* in comparison to benzyl penicillin and streptomycin. It also had inhibitory effect on *Candida albicans* and *Cryptococcus neoformans* [20].

Antihypertensive Activity: The effect of plantains on deoxy-corticosterone acetate (DOCA) induced elevation of mean arterial blood pressure in albino rats has been studied. The consumption of plantain diet by rats, previously treated with DOCA lowered the mean arterial blood pressure to control values. Also, no significant change in the mean arterial blood pressure compared to control was seen in the rats, which were administered DOCA following a previous diet of plantain. Chronic consumption of plantain is capable of lowering DOCA induced elevated mean arterial blood pressure and also prevent the onset of DOCA induced hypertension in the rats [21].

Antidiarrhoeal Activity: A clinical trial was conducted to evaluate the efficacy of a solution of 50 gm/L of plantain flour and 3.5 gm/L of sodium chloride for rehydration of children with acute diarrhoeal disease. 121 children were given WHO-ORS and 117 the plantain flour based solution. The plantain flour based solution proved effective for the treatment of dehydration due to acute diarrhoeal diseases [22].

In a double blind clinical trial with an aim to evaluate the therapeutic effects of green banana against pectin in children with persistent diarrhoea, 62 boys aged 5–12 months were randomly given a rice based diet containing either 250 gm/lit of cooked green banana or 4 gm/kg pectin or the rice diet alone for 7 days. Green banana and pectin significantly reduced amounts of faeces passed, oral rehydration solution/intravenous fluid requirement and number of vomiting and diarrhoeal duration. Green banana and pectin are useful in the dietary management of persistent diarrhoea in hospitalized children and may also be useful to treat children at home [23].

Anti-allergic activity: Ripe *M. sapientum* pulp water extract has been reported to have

significant anti-allergic activity on antigen-induced degranulation in RBL-2H3 cells with an IC 50 value of 13.5 ± 2.4 [24].

Antioxidant activity: Methanolic extracts of peel (MSPE), pulp (MSPU) and seed (MSSE) of the fruit of *Musa sapientum* were investigated for in vitro antioxidant activity using DPPH (1,1-diphenyl-2-picrylhydrazyl) radical scavenging capacity, reducing power, CUPRAC (Cupric Reducing Antioxidant Capacity) and total antioxidant capacity. The plant extracts showed a direct concentration dependent increase in scavenging DPPH radical. MSSE showed better scavenging activity than MSPE and MSPU with an IC 50 value of $54.92 \mu\text{g/ml}$. The Fe^{3+} /ferricyanide to ferrous and cupric ion reduction capacity of MSSE were better than the reference agent ascorbic acid. All three extracts showed good results in total antioxidant assay [25].

The extracted flavonoids from *M. paradisiaca* on administration to rats, stimulated the activities of superoxide dismutase (SOD) and catalase which might be responsible for the reduced level of peroxidation products such as malondialdehyde, hydroperoxides and conjugated dienes [26].

In a study, antioxidant activity of banana peel was evaluated using thiocyanate method, β -carotene bleaching method, DPPH free radical scavenging method. Antioxidant activity of water extracts was comparable to those of synthetic antioxidants such as butylated hydroxyanisole and butylated hydroxy-tolueneis [27].

The effects of a single banana meal on plasma lipids and lipoprotein profile, plasma oxidative stress and susceptibility of LDL to oxidation was studied in 20 healthy volunteers. Before meal (baseline, fasting) and 2 h after meal (post-dose) Lipid and lipid peroxide (LPO) levels were measured. The susceptibility to copper-induced oxidation of baseline and post-dose LDL was measured as conjugated diene (CD) formation. Results showed that the LPO contents in plasma, very low density lipoprotein (VLDL), LDL and high density lipoprotein (HDL) decreased

significantly in the 2 h post-dose phase. Results suggest that the consumption of banana reduces the plasma oxidative stress and enhances the resistance to oxidative modification of LDL [28].

Analgesic activity: The analgesic activity of aqueous and ethanolic leaf extracts of *Musa sapientum*, (400mg/kg and 400mg/kg, i.p.) significantly increased reaction time in hot plate method as compared to vehicle treated group. Maximum analgesic effect was observed at 2 hrs [29].

Diuretic activity: Ash of the peel of *M. sapientum* showed an increase in urine volume and K^+ as well as other electrolyte excretion than normal saline in a study in rats. Successive ethanolic extract also give this diuretic effect [30]. Phytochemicals such as saponin, flavonoids and terpenoids are known to be responsible for this effect [31, 32, 33].

Hypolipidemic Activity: A study of the effect of dietary fibre from unripe plantain banana on cholesterol metabolism revealed that, albino rats fed natural detergent fibre (NDF) from unripe plantain banana showed significantly lower levels of cholesterol and triglyceride in serum and tissues in both cholesterol diet and cholesterol free diet groups, when compared to control rats fed fibre free diet. Concentration of bile acids was high in rats fed NDF in both groups. Absorption of glucose and cholesterol in rabbits was significantly lowered in presence of NDF from unripe banana [34].

A study was carried out on a hypolipidemic principle of the inflorescence stalk of plantain. A pectin present in the juice inflorescence stalk of *Musa sapientum*, administered to rats fed both cholesterol free, and cholesterol containing diets, showed significant lowering of cholesterol and triglyceride in the serum, liver and aorta [35].

Hypoglycaemic Activity: Following a study on rabbits, it was reported that *Musa sapientum* fruit showed significant antihyperglycaemic activity. The results showed significant decrease in the hyperglycaemic peak and/or the area under the glucose tolerance curve [36].

A study was carried out on antihyperglycaemic activity and effect on lipid peroxidation of *Musa sapientum* flowers in alloxan induced diabetic rats. Oral administration of 0.15 to 0.20 and 0.25 gm/kg of the chloroform extract to albino rats for 30 days resulted in a significant reduction in blood glucose and glycosylated haemoglobin and increase in total haemoglobin. There was decrease in thiobarbituric acid reactive glutathione, glutathione peroxides, superoxide dismutase and catalase. Thus the study shows that banana flower extract has hypoglycaemic and antioxidant property [37].

Hair Growth promoting activity: The extract of *Musa paradisiaca* unripe fruit when tested for the hair growth activity was assayed by studying hair length and microscopic study of follicles in vehicle control, 2% minoxidil treated and extracts treated animals. The findings suggest that extract of *Musa paradisiaca* unripe fruit has potential as a hair growth promoter [38].

Muscle Relaxant Activity: A study on the effect of extract of banana stem juice on directly and indirectly evoked contractions of isolated phrenic nerve hemidiaphragm preparation of mouse, showed that the extract first augment both the evoked contractions then block them. Two major constituents probably responsible for the activity were isolated from the extract and they were potassium nitrate and magnesium nitrate [39].

Haemostatic Effect of the Stem Juice of *Musa paradisiaca* L: This experiment was conducted to scientifically investigate the possible haemostatic effect of *Musa paradisiaca* stem juice in guinea pigs using bleeding and clotting times. It was observed that blood clotting and bleeding times were both significantly reduced ($p < 0.05$) when the stem juice was introduced. These results are important to present, since it is the first report on haemostatic effects of *Musa paradisiaca* L. stem juice in animals. These results suggested that the stem juice of *Musa paradisiaca* possesses haemostatic properties, justifying its folklore use [40].

Mutagenicity: The mutagenic effect of

M. paradisiaca fruit peel extract in mice was assessed by the single-cell gel electrophoresis (SCGE) and micronucleus assays. The experiments showed DNA damaging property in peripheral blood leukocytes for 1500 and 2000 mg/kg body weight [41].

Vasodilatory Activity: The effect of aqueous extract of plantain on the contractile response of rats' aorta and portal veins was studied. It was observed that the extract produced relaxation of the contracted aortic rings, induced by noradrenaline and potassium chloride and completely abolished the spontaneous contraction of the portal veins [42].

Wound healing activity: The wound healing activity of both methanolic and aqueous extract of plantain banana in rats was studied and both extracts were found to increase hydroxyproline, hexuronic acid, hexosamine and superoxide dismutase as well the wound breaking strength and reduced glutathione level. They also decreased the wound area, scar area and lipid peroxidation. The effects were attributed to the antioxidant property of the plantain [43].

Conclusion

Banana plant has medicinal properties. Different parts of the banana plant are used for various traditional medicinal purposes. Roots and stems are used as tonic, antiscorbutic, useful in blood and venereal diseases. Unripe fruit in combination with other drugs used in diabetes. Juice of flowers mixed with curds used in dysentery and menorrhagia. Young leaves are used as a cool dressing for blisters and burns [5]. Apart from traditional uses, there are several reports on important pharmacological actions. After observing the pharmacological studies reported in the review it would be necessary to carry out further studies to confirm the true potential of *Musa sapientum* and *Musa paradisiaca*, so that they may be clinically applicable and commercially viable.

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