Phytochemical and Pharmacological Property Review of *Musa Paradisiaca*

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ABSTRACT

Musa paradisiaca is a plant normally named as banana which is a member of the Musaceae group. The various elements of the plant are widely used to cure various illness in humans like diabetes, diarrhoea, dysentery, hypertension, hysteria, epilepsy, leprosy, haemorrhages, renal calculi, and ulcers. The documented pharmacological advantage of this plant are antilithiatic, antioxidant, antibacterial, antidiabetic, antiulcer, antidiarrheal, hypocholesterolaemic, hepatoprotective, anti-snake venom, wound healing, hair growth promoting, antifungal, and antimenorrhagicactivity. This review converse the features on predictableuses and pharmacological advantages of Musa paradisiaca. Phytochemical studies have reported several secondary metabolits from the plant. Musa paradisiaca has numerous phytochemicals and has a substantial pharmacologicalactivity that can help to boost different health issues.

KEY WORDS: Musa paradisiacal, Ethnomedicine, Phytochemicals, Bioactivity.

INTRODUCTION

Banana plants represent some of the largest herbaceous plants existing in the present, with some reaching up to 9 metres (30 ft) in height. The large herb is composed of a modified underground stem (rhizome), a false trunk, a network of roots, and a large flower spike. The false trunk is an aggregation of the basal portion of leaf sheathes; it is not until the plant is ready to flower that a true stem grows up through the sheath and droops back down towards the ground.[1, 2] At the end of this stem grows a peduncle with many female flowers protected by large purple-red bracts. The extension of the stem (this part called the rachis) continues growth downward where a terminal male flower grows. The leaves originate from a pseudostem and unroll to show a leaf blade with two lamina halves.[3] Musa paradisiaca reproduces by both sexual (seed) and asexual (suckers) processes, utilizing asexual means when producing sterile (non-seedy) fruits. Further qualities to distinguish Musa paradisiaca include spirally arranged leaves, fruits as berries, latex-producing cells present, 5 connate and 1 member of the inner whorl distinct, and petiole with one row of air channels[4].

Musa paradisiaca sapientum stands for bananas which are known for their edible fruits and *Musa paradisiaca paradisiaca* standing for 'Plantains' and are generally larger, more angular starchy fruits of hybrid triploid cultivars in the banana family intended for cooking [5,6]. Various parts of *M. paradisiaca* have been used for various medicinal purposes. It has traditionally been used for antidepressant, antibacterial, antihypertensive, antiulcerogenic [6-7] urolithiasis [8] laxatives, antihelminthics. This indigenous knowledge, passed down from generation to generation in various parts of the world, has significantly contributed to the development of different traditional systems of medicine [9] as well as helped in exploration of different medicinal plants to find the scientific basis of their traditional uses.

Monographs

English	: Banana tree
Hindi	: Kelaa, Kelaa kaa phuul
Tamil	: Vazhei
Telugu	: Artipandu
Kannada	: Balayhanu
Malayalam	: Pisang
Gujarati	: Kel phool
French	: Banane
Thailand	: Kluai

Taxonomy

Kingdom	: Plantae
Subkingdom	: Tracheobionta
Super Division	: Spermatophyta
Division	: Magnoliophyta

Class	: Liliopsida
Subclass	: Zingiberidae
Order	: Zingiberales
Family	: Musaceae
Genus	: Musa
Species	: paradisiaca

Origin of Bananas

The genus Musa paradisiaca was first named by Carl Linnaeus in 1753.[10] The name is a Latinization of the Arabic name for the fruit, mauz. Mauz meaning Musa paradisiaca is discussed in the 11th-century Arabic encyclopedia The Canon of Medicine, which was translated to Latin in medieval times and well known in Europe. Muz is also the Turkish, Persian, and Somali name for the fruit. Some sources assert that Musa paradisiaca is named for Antonius Musa paradisiaca , physician to the Emperor Augustus.[11,12] According to Roger Blench, the ultimate origin of Musa paradisiaca is in the Trans–New Guinea languages, whence they were borrowed into the Austronesian languages and across Asia, via the Dravidian languages of India, into Persian, Greek and Arabic as a Wanderwort[13].

Cultivated Bananas

A number of distinct groups of plants bearing edible fruit have been developed from species of Musa paradisiaca . In English, fruits which are sweet and used for dessert are usually called "bananas", whereas starchier varieties used for cooking are called "plantains", but these terms do not have any botanical significance[14]. By far the largest and now the most widely distributed group of cultivated bananas is derived from section Musa paradisiaca, particularly M. acuminata and M. balbisiana, either alone or in various hybrid combinations. The next but much smaller group is derived from members of section Musa paradisiaca (previously classified as AustraliMusa paradisiaca) and is restricted in importance to Polynesia. Of even more restricted importance are small groups of hybrids from Papua New Guinea; a group from section Musa paradisiaca to which Musa paradisiaca schizocarpa has also contributed, and a group of hybrids between section Musa paradisiaca and section CalliMusa paradisiacal[15,16].

Figure 1. *Musa paradisiaca* with flowers

Morphology

The Banana plant, Musa paradisiaca often erroneously referred to as a "tree", is a large herb, with succulent, very juicy stem, which is a cylinder of leaf-petiole sheaths, reaching a height of 20 to 25 ft (6-7.5 m) and arising from a fleshy rhizome or corm. Leaves are tender, smooth, oblong or elliptic numbering 4 or 5 to 15, arranged spirally and they unfurl, as the plant grows, at the rate of one per week. The inflorescence, a transformed growing point, is a terminal spike shooting out from the heart in the tip of the stem[17,18]. At first, it is a large, long-oval, tapering, purple-clad bud. As it opens, it is seen that the slim, nectar-rich, tubular, toothed, white flowers are clustered in whorled double rows along the floral stalk, each cluster covered by a thick, waxy, hood like bract, purple outside, deep-red within. Female flowers occupy the lower 5 to 15 rows. Above them may be some rows of hermaphrodite or neuter flowers. Male flowers are borne in the upper rows. The bracts are soon shed and the fully grown fruits in each cluster become a "hand" of Bananas, and the stalk droops with the weight until the bunch is upside down. The fruit turns from deep-green to yellow or red, or, in some forms, greenand white-striped[19].

Traditional uses

Many traditional uses of banana have been well documented, for example, the leaf and stem are used to treat diarrhoea; the stem is good for asthenia and wounds, and the leaf for the treatment of inflammation, headache and rheumatism [20]. Previous studies reported that *M. Paradisiaca* had antimicrobial and healing activities. Nevertheless, only a few studies have reported on the efficacy of this plant against nematodes [21].Various parts of *M. Paradisiaca* have been used for various medicinal purposes. It has traditionally been used for antidepressant, antibacterial, antihypertensive, antiulcerogenic [22] urolithiasis [23] laxatives, antihelmin, analgesic, antifungal, constipation, wound healing, fevers, burns, diarrhoea, inflammation, pains and antivenomic for snake bites [24]. Flowers are used in dysentery and menorrhagia. Stem juice of fruited plant is used for treating diarrhoea, dysentery, cholera,

otalgia, haemoptysis and flower is used in dysentery, diabetes and menorrhagia [25]. The root is used as antihelmintic [26], blood disorders and venereal diseases [27].

Phytochemicals and mineral contents:

Catecholamines such as norepinephrine, serotonin, dopamine [28]. Tryptophan, indole compounds [29]. pectin have been found in the pulp. Several flavonoids and related compounds (Leucocyanidin, quercetin and its 3-Ogalactoside, 3-O-glucoside, and 3-O-rhamnosyl glucoside) were isolated from the unripe pulp of plantain. Serotonin, nor-epinephrine, tryptophan, indole compounds, tannin, starch, iron, crystallisable and non-crystallisable sugars, vitamin C, B-vitamins, albuminoids, fats, mineral salts have been found in the fruit pulp of *M. paradisiaca* and *M. sapientum*.Carbohydrates have been isolated from *M. sapientum*. Cellulose, hemicelluloses, arginine, aspartic acid, glutamic acid, leucine, valine, phenylalanine and threonine have been isolated from pulp and peel of *M. paradisiaca*. Hemiterpenoid glucoside (1,1-dimethylallylalcohol), syringin, (**6S**, 9R)-roseoside, benzyl alcohol glucoside, (24R)-4α,l4 α,24-trimethyl-Sacholesta-8,25(27) dien-3β-o1 have been isolated from flower of *M. paradisiaca* [30].

PHARMACOLOGICAL ACTIONS

The various effects of *Musa paradisiaca* Linn.are documented in traditional as well as scientific literature. The main pharmacologial effects of this plant are anti-diabetic activity, antiulcer activity, antioxidant property, wound healing, hair growth promoter, diuretic, analgesic, augmenting action on skeletal muscle contraction, antihypertensive activity, anti-allergic activity and mutagenic effects and haemostatic activity in which a few are reported.

Antifungal activity

Effect of plantain Musa paradisiaca peel and stalk extracts were investigated for determining the antifungal action, using percentage inhibition test. Complete inhibition of growth (100%) was observed for Aspergillus niger, Aspergillus oryzae and Rhizopus stolonifer at 1.0 mg/ml concentration of stalk extract. Peel extract inhibited A. niger 100%, A. oryzae 76.67% and R. stolonifer 56.67% at the same concentration. As concentration reduces, growth inhibition reduces also up to the minimum inhibitory concentration[31]. The results further justify the claim that Musa paradisiaca stalk and peel extract demonstrated antifungal action in which methanol was seen to be a better solvent for extracting active ingredients from medicinal plants considering the high susceptibility of test organisms to methanol extract than ethanol extract[32].

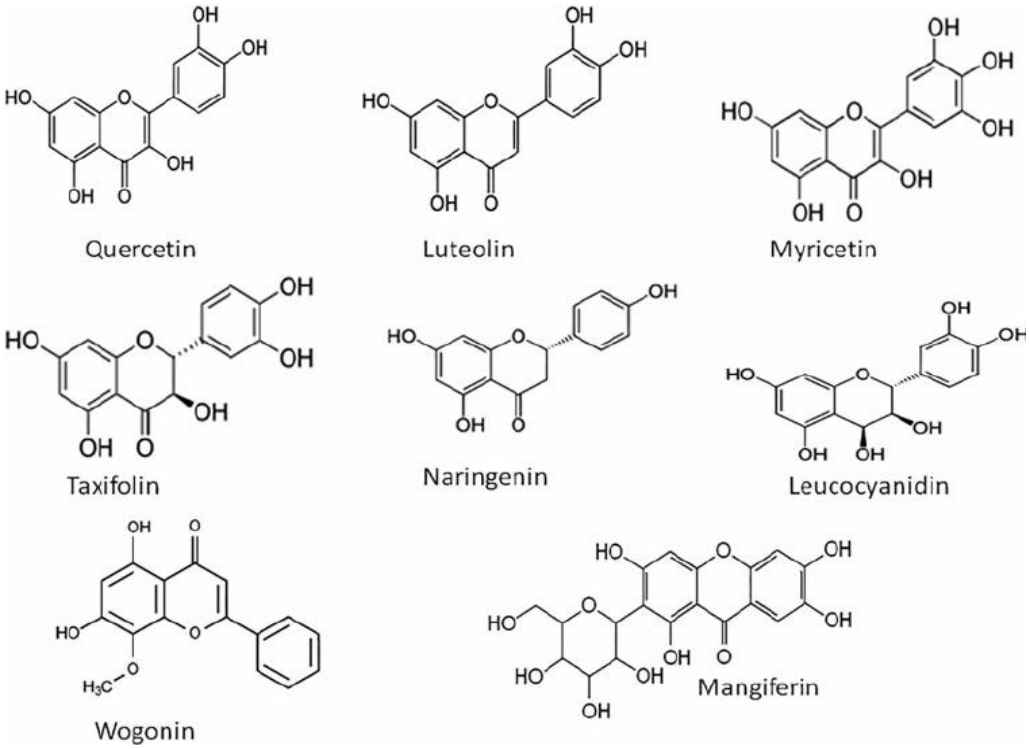

Figure 2. *Musa paradisiaca* active chemical constituents

Antidiabetic activity

Aqueous extracts and methanolic fractions of M. paradisiaca flowers and bract produced antidiabetic effect in male Wistar rats experimentally induced diabetes using intravenous streptozotocin (STZ). All the extracts and fractions, however, had improvement relative to the untreated control group due to the presence of flavonol glycoside and anthocyanins in the fractions and extracts which have severally been shown to possess anti-hyperglycaemic activity[33]. Validate the antidiabetic activity of methanolic flower extract attributable to the polyphenolic compound and dietary fibres present, thus backing calls for the exploration of inflorescence as a potential functional food and/or nutraceutical with excellent nutritional and organoleptic properties[34].

Antiulcer activity

Histological studies showed that banana treatment sections showed a greater aggregation and intensity of pink spots when compared to controls. This study suggests that banana powder treatment not only strengthens mucosal resistance against ulcerogens but also promotes healing by inducing cellular proliferation[35]. The active ulcerogenic ingredient was extracted from unripe plantain banana by solvent fractionation and identified by chromatography, spectroscopy and HPLC. As the flavanoidleucocyanidin and purified synthetic leucocyanidin demonstrated significant ($p<0.05$) protective effect against aspirin induced erosion. Extracts of plantain (*Musa paradisiaca* Linn. var. paradisiaca was studied on the accumulation of eicosanoids in incubates of human gastric and colonic mucosa. The extract (50mg/kg twice daily for 5 days) showed significant antiulcer effect and antioxidant

activity in gastric mucosa homogenates where it reversed the increase in ulcer index, lipid peroxidation and superoxide dismutase values induced by stress [36].

Antioxidant property:

The antioxidant behavior of the extracts was evaluated by using the thiocyanate method, ß-carotene bleaching method and 1, 1-diphenyl-2-picrylhydrazyl (DPPH) free radical elimination. Antioxidant activity of water extracts was comparable to those of synthetic antioxidants such as butylated hydroxyanisole and butylated hydroxytoluene and it shows a significant antioxidant property. The antioxidant effects of crude extracts from green banana and yellow peel were investigated and the results indicated that the extract of green peel recorded more significant activities than that of yellow peel at other solvents extracts [37].

Wound healing activity:

The rats were given graded dose of (50-200 Kg/day) of aqueous and methanolic extract of *Musa paradisiaca sapientum* var. paradisiaca orally for a period of 10-21 days depending upon the type of study. Both extracts when studied for incision and dead space wounds parameters increased wound breaking strength and levels of hydroxyl proline, hexuronic acid, hexosamine, superoxide dismutase, reduced glutathione in the granulation tissue and decreased percentage of wound area, scar area when compared with the control group both the extracts showed good safety profile [38].

Hair growth promoting activity:

For the evaluation of the hair growth promoting activity of Musa paradisiaca paradisiaca unripe fruit extract, the study was aimed to investigate the hair growth promoting activity of *Musa paradisiaca paradisiaca* unripe fruit extract. The mice were divided into four groups the extract and minoxidil were applied over the shaved skin surface on to the backs of mice and monitored for 30 days. The extract of *Musa paradisiaca 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 paradisiaca* unripe fruit has potential as a hair growth promoter [39,40].

Analgesic activity:

The analgesic activity of aqueous extract of the plant was evaluated using the hot plate method and writhing test in mice. The hot plate method is useful in detecting centrally acting analgesics whereas acetic acid induced writhing method is useful to detect peripheral analgesic effects. Acetic acid, which is used as an inducer for writhing syndrome, causes analgesia by liberation of endogenous substances, which then excite the pain nerve endings. The fact that aqueous extract of *Musa paradisiaca paradisiaca* showed analgesic activity in both the models studied, indicate that this effect could be due to the presence of two components; one acting centrally and the other via peripheral route from the above results, it can be deduced that aqueous extract has shown dose dependent activity. As the phytochemical screening has shown the presence of carbohydrates, sterols, proteins,

flavonoids, alkaloids in aqueous extract of *Musa paradisiaca paradisiaca* leaves, its potent activity may be attributed to the presence of these phytoconstituents [41-45].

Augmenting action on skeletal muscle contraction:

Augmentation action in skeletal muscles was studied by taking an extract obtained from juice expressed from the stem of the plantain banana tree (*Musa paradisiaca sapientum* L., var. paradisiaca) induces twitch augmentation in skeletal muscle. The mechanism of this action was investigated in the mouse hemi-diaphragm preparation. Directly evoked twitches and potassium induced (K+) contractures were both increased by the extract [46-48].

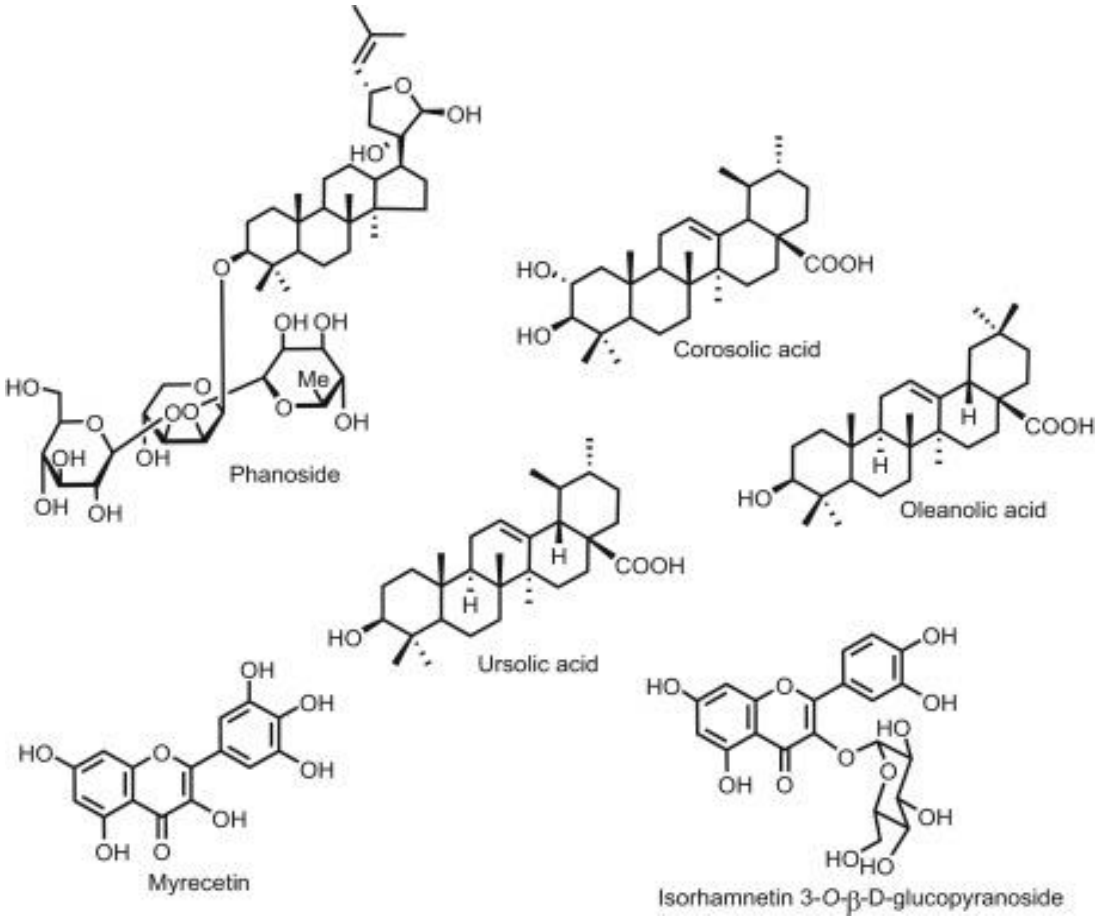

Figure 3. Active chemical constituents *in Musa paradisiaca*

Antidiarrheal activity

The banana cellulose (a soluble polymer) will make smoother and cease constipation. However, consumption of banana could be an advantage in individuals hurting from symptom. In a study, thirty one patients with symptom were randomised to receive either banana flakes or medical treatment for illness. The investigators observed that the banana flake cluster had fewer symptoms clinically; with fifty seven of the topics were diarrhoea free on their last study day in differentiation to pure gold of the medically treated subjects. This study shows the disease curing activity of plantain tree[49-52].

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 [53]. Phytochemicals such as saponin, flavonoids and terpenoids are known to be responsible for this effect [54-56].

Antihypertensive activity:
The antihypertensive effect of *M. paradisiaca* in albino rats was reported. Banana diet has a mean arterial blood pressure lowering as well as onset preventing effect in rats with elevated blood pressure induced by desoxycorticosterone acetate (DOCA) administration [57]. The antihypertensive effect of ripe banana pulp in deoxycorticosteroneenantate-induced hypertensive rats which may be due to the high tryptophan and carbohydrate content of banana that increases serotonin levels and gives serotonin-mediated natriorexic effect [58-62].

Antimenorrhagic activity
Consuming one cooked banana flower with one cup of curd or yogurt is one of the most efficient ways of treating excessive bleeding during menstruation[63-67]. The cooked banana flower and curd combination increases the level of progesterone in the body and thereby reduces bleeding associated with menorrhagia. The flowers are also taken as an infusion in normal doses for painful menstruation.

Hepatoprotective activity
Parts of M. balbisiana have also been reported to have hepatoprotectiveactivity. The basal diet supplementedwith dried banana fruit or banana peels at the two studied levels (5%and 10%) caused a significant decrease ($P<0.05$) in the elevate level ofserum glucose, urea, uric acid, creatinine, triglycerides, total cholesterol,low-density lipoprotein, very low-density lipoprotein, aspartateaminotransferase, alanine aminotransferase, and alkaline phosphataselevels, and significantly increased ($P<0.05$) the concentrations of highdensity lipoprotein and insulin activity as compared to the controldiabetic rats[68-69]. The present study demonstrates that banana fruit andits peel have hepatoprotective, hypoglycemic effects against diabetichepatotoxic rats. The result revealed that all cows responded well to the giventreatment regimen showing therapeutic potential as hepatoprotectiveand strong antioxidant properties.

Anti-allergic activity:
The water extract of pulp of ripe *M. sapientum* has been reported to have significant anti-allergic activity on antigen induced degranulation in RBL-2H3 cells with an IC50 value of 13.5±2.4[70].

CONCLUSION
Medicinal plants have attracted significant world interest in past years. Banana tree could be a healthful plant with numerous pharmacological properties. The leading pharmacological outcome of this plant are antilithiatic, antioxidant, antibacterial,

antidiabetic,antiulcer,antidiarrheal, hypocholesterolaemic, hepatoprotective, antisnakevenom, wound healing, hair growth promoting, antifungal, and antimenorrhagic actions. Because of the therapeutic effect, there is a vast range of future research on Musa paradisiaca. Different parts of M. paradisiaca have been studied extensively and found to modulate physiological activities and antimicrobial effects on various microorganisms. However, as against most of the conventional antimicrobials used in pharmacological and cosmetics preparations, the mechanisms of actions of this potent antimicrobial and medically active plant on each of the applications have not been well studied. Similarly, while antimicrobial—generally—studies are extensive, limited antiviral and in vivo reports exist. Putatively, the bioactive metabolites that appear to mediate antimicrobial activity are stigmasterol and β-sitosterol (phytosterols) and the triterpenes trio of 31-norcyclolaudenone, 24-methylene-cycloartanol, and cycloeucalenone. The paucity of in vivo and antiviral studies are gaps that require to be earnestly. Musa paradisiaca has numerous phytochemicals and has a substantial pharmacologicalactivity that can help to boost different health issues.

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