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A Review On Pharmacological Activities Of Banana (Musa Paradisiaca)

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ABSTRACT: Popular medicinal plant Musa paradisiaca var. sapientum Linn. is a member of Musaceae family. The fruit from plant, sometimes called plantain or a banana, is a very nutrient-dense food that is consumed all over the world. From this plant, a variety of phytochemical components have been extracted. It has a lengthy history of usage in conventional Ayurvedic Indian medicine for a range of illnesses. With a weight of 125 g on average, the fruit contains 25% dry matter and around 75% water. Bananas are a virtuous source of potassium, vitamin C & vitamin A. The plant is testified to have anti-oxidant, anti-diuretic, antimicrobial, antidiarrheal, antiulcer genic, anti-allergic, antimalarial, wound healing, antihypertensive, hypoglycemic, analgesic, hepatoprotective, vasodilatory, hair growth promoting, antilitiatic, hypolipidemic, antidepressant, cytotoxic and thrombolytic, anticonvulsant, antisnake venom, adaptogenic, mutagenic activities. This review focuses on the traditional usage, phytochemistry & pharmacological prospective of the banana plant.

KEYWORDS: Phytochemistry, Musa Paradisiaca, Banana, Pharmacological Activity

I. INTRODUCTION :

Humanity has used herbal remedies since the dawn of time. The oldest Indian traditional system, Ayurveda, shows that prehistoric Indians had a thorough understanding of the therapeutic benefits of various plants. Due to the unsafe climatic and geographic variations found throughout the nation, India has a very diverse and abundant flora. The highly prized medicinal plant Musa paradisiaca Linn., also called as Kadali in Sanskrit, is used extensively in India's traditional medical system to treat a variety of ailments.[1]

Around the world, Musa paradisiaca is grown in tropical and subtropical regions. The fruit of the Musa species is frequently referred to as a banana[3]. Traditional medicines have used various parts of the banana for various ailments. The roots & stems are used as tonics, antiscorbutic and therapeutics for venous and blood disorders. Unripe fruit combined with other diabetes medications. A mixture of floral juice and curds is used to treat menorrhagia and dysentery. Young leaves are applied to blisters and burn as a cooling dressing [4].

The presence of the fruit's diverse phyto-constituents, which include fatty acids, stearyl esters and sterols in addition to oleic & linoleic acids, is thought to be the reason why bananas are so useful both traditionally and pharmaceutically[5]. The majority of the plants are bulky persistent herbs by rhizomes, plucky stems as well as branched plants. The fruit is a soft, fleshy, leathery, or woody capsule[4]. Both terms are used according to how the fruits are eaten; there is no official botanical distinction between bananas and plantains. Citizens of Southeast Asia's tropical areas make up the whole genus Musa[6].

The fruit of M. paradisiaca is a worthy source of vitamins C & E as well as natural resources like potassium, phosphorus, calcium, nitrogen and iron.[3] The bioactive substances produced by plant secondary metabolism have a clear therapeutic potential in addition two elements like phosphorus and potassium by influencing their pharmacological activities[7]. Banana skin contains a variety of ingredients, including enzymes like polyphenol oxidase and pectin, which is used as a gelling agent and in creams and ointments. The extract from banana peels has medicinal uses that include reducing pain, swelling, and itching.[8]

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Fig.1: Banana Plant

TAXONOMICAL CLASSIFICATION: [9]

Kingdom	: Plantae
Subkingdom	: Tracheobionta
Superdivision	: Spermatophyta
Division	: Magnoliophyta
Class	: Liliopsida
Subclass	: Zingiberidae
Order	: Zingiberales
Family	: Musaceae
Genus	: Musa L.
Species	: M. paradisiaca L.

Vernacular Names: [1]

English	: Plantain or Banana
Sanskrit	: Vanalaxmi, Kadali, Rambha
Hindi	: Kela
Marathi	: Kela
Gujarati	: Keda
Sindhi	: Kewiro
Telugu	: Kadalamu, Ariti
Tamil	: Kadali
Malayalam	: Vasha
Konkani	: Keli

Fig.2: Banana Fruit

Fig.3: Banana Flower

ORIGIN AND CULTIVATION:

The history of the banana is as complicated and convoluted as the taxonomic history of the banana itself. Archaeologists have concentrated on the Kuk valley of New Guinea as the location where humans domesticated the banana for the first time around 8,000 BCE. Although this is the first place where subjugation of bananas is known to have taken place, subjugation of bananas may have happened elsewhere in Southeast Asia. As a result, Kuk is the first known example of banana domestication, though it is unlikely to be the source of domestication for all other species.[10]

There are about 300 different varieties of bananas grown around the world, the massive majority of which originated in the tropical regions of Asia, Indo-Malaysia, and Australia and are now cultivated in maximum tropical and subtropical nations. The top producing nations for bananas are India, China, Ecuador, Costa Rica, Colombia Brazil, Indonesia, Mexico and Thailand. Throughout the year, the banana is almost always in bloom somewhere in the nation. However, Rangamati, Dinajpur, Noakhali, Barisal, Rangpur, Faridpur, and Khulna are the main banana-growing regions [9].

TRADITIONAL USES:

The root is anthelmintics, antibilious, and a valuable alternative. When there is bleeding, tender root juice is used. Additionally, it's used for cachexia and anemia. Root juice is used to treat strumous affections, gonorrhea, bronchocele, and urinary retention. Flowers are astringent. To treat diabetes, cooked flowers are used. A mixture of flower juice and curds is used to treat menorrhagia and dysmenorrhoea. Stem juice is used for hemoptysis and otalgia. Completely ripe fruit taken in the early mornings is purgative, soothing, demulcent, and nutritive. The unripe fruit is used in

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diabetes, diarrhea, and dessert because it is calming, astringent, and antiscorbutic (in a dry state). Chapatti is made using green plantain flour, which is utilized in dyspepsia situations with bloating and acidity. Blisters and nipped wounds are dressed with the leaves to keep them cool. [1].

NUTRITIONAL COMPONENT:

The fruit banana is loaded with nutrients. It is an excellent source of calories, vitamins, macronutrients, and vital amino acids, and it may be used as infant food. [11]. The banana pulp contains 72% moistness, 1.28% ash, 2.9% total fiber, 1.4% protein, 14.4% sucrose, 2.4% glucose, 2.1% fructose, and 8.5% ascorbic acid. The distribution of nutrients varies among the pulp's various components, with the central region which houses the seeds having the highest supply [12]. Micronutrients like zinc, manganese, copper, iron, potassium, calcium, magnesium, sodium, phosphorus, and nitrogen are all present in bananas in significant amounts [13].

Depending on the stage of ripening, a banana has different physicochemical properties. For instance, a banana that is just starting to ripen is used to make bakery goods because it has main quantity of starch and little sugar content, whereas a banana that is fully ripened is best used to make baby food because it has extra bioactive mixtures and a higher sugar & fat contented [14]. A halting foodstuff blend centered on bananas was created, containing 4.03 g of reducing sugar for every 100 g of total sugar, 58.07 g of carotene, 13.56 g of protein, 1.26% crude fiber, 0.77% tannin and 1.33% ash. By giving the formulated weaning mixture to 4-5 month old babies for six months, the purity of the concocted food mixture was examined. Constant rises were seen in all anthropometric sizes including height, weight, head, trunk, arm & leg circumference [8]. In comparison to the two varieties of Musa acuminate (Cavendish banana and Red Dacca), the pulp of Musa sapientum has a lesser starch content and glycemic index, which may be helpful for controlling blood sugar levels.[15]

PHYTOCHEMICAL CONSTITUENTS:

Tannic and gallic acid are found in the plant's growing segments. The apt fruit has 22% sugar, 4.8% albuminoids, 1.0% fat, 6.8% to 13.3% non-nitrogenous extractives, and starch. It contains significant amounts of vitamin C and a small quantity of vitamin B [1]. Several phenolic acids and flavonols have been testified to be existing in the pulp and peel of banana (plantain cultivars), including ferulic acid, sinapic acid, ferulic acid-hexoside, sinapic acid-hexoside, caffeic acid-hexoside, hydroxycinnamic acid, quercetin-deoxyhexose, myricetin-deoxyhexose, kaempferol-3-O-rutinoside, epicatechin, rutin, isorhamnetin-hexoside and other unidentified combinations that are answerable for reported health encouraging properties [16].

According to studies the banana pulp contains valued lipophilic compounds like linoleic acid (-3) and linoleic acid (-6) as well as -tocopherol and -sitosterol, which is beneficial in the treatment of prolonged diseases like cancer & cardiovascular disease.[17] These lipophilic components are also present in the pulp of certain Musa species' immature peels, which have been shown to include 38 bioactive substances from the steroid and fatty acid families by high-value phytochemical potentials. [18].

The fruit is found to be very nutrient-dense on both a micro and macro level. The ripe fruit has higher concentrations of phosphorus and manganese, whereas the unripe fruit has higher concentrations of calcium and selenium. The three main amino acids found in ripe fruit are aspartic acid, glutamic acid, and leucine [11]. The ripe fruit's husk is made up of potassium and soda carbonates, potassium chloride, alkaline phosphates, and lime silica. There is a lot of tannin in green plantains. Potash, sodalime, magnesia, alumina, chlorides, sulphuric anhydride, phosphoric anhydride, silica and carbon anhydride are the ingredients in plantain flower stem juice [1].

Reported Pharmacological Activities:

Several pharmacological effects of bananas are discussed in this section, with a focus on those that are more important to healthcare.

- **Anti-Oxidant Activities:**

After being administered to rats, the flavonoids from M. paradisiaca stimulated the actions of catalase and superoxide dismutase (SOD), which may be the cause of the reduced levels of peroxidation products like malondialdehyde, hydro peroxides, and conjugated dienes [19].

A single banana meal's effects on the lipid and lipoprotein profile, plasma oxidative stress, and LDL's susceptibility to oxidation were studied in 20 healthy participants. Lipid and lipid peroxide levels were restrained 2 hours after a meal (post-dose) and before meal (baseline, fasting). Conjugated diene

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(CD) formation was used to assess the susceptibility of baseline and post-dose LDL to copper-induced oxidation. The findings demonstrated that in the 2 hour post-dose phase, plasma levels of LPO, low-density lipoprotein, very low-density lipoprotein, and high-density lipoprotein all reduced significantly. According to the data, eating bananas drops plasma oxidative stress besides strengthens LDL's resistance to oxidative variation [2].

- **Anti-Diuretic Activity:**

In a study, the ash of the peel of M. sapientum increased the excretion of K, other electrolytes, and urine volume compared to normal saline. The following ethanol extract also has this diuretic effect [20].

- **Anti-Microbial Activity:**

M. paradisiaca var. sapientum's green fruit peels and leaves have been found to have antibacterial action against Staphylococcus and Pseudomonas species in a dehydrogenase test. In comparison to Staphylococcus & Pseudomonas species, the IC50 of fruit skin extract was 143.5 and 183.1 g/ml, and in the example of leaf extract, it was 401.2 and 594.6 g/ml [21].

In this test, fruit peel cutting confirmed superior antibacterial activity versus both bacteria compared to leaf extract, while peel extract proved superior antibacterial activity versus Gram-positive Staphylococcus compared to Gram-negative Pseudomonas species. However Salmonella paratyphi, Staphylococcus aureus, Shigella dysenteriae, Bacillus subtilis, Escherichia coli and Candida albicans were not vulnerable to the alcohol-based extract of M. paradisiaca stem [22]. According to studies, unripe M. sapientum fruit extracts in both ethanolic and aqueous systems were effective against a range of bacteria, including S. aureus ATCC 25921, S. aureus, Shigella flexneri, Salmonella paratyphi, E. coli ATCC 25922, E.coli, Klebsiella pneumoniae, Pseudomonas aeruginosa and B. subtilis. Unripe bananas had a lowest bactericidal concentration (MBC) of 32-512 mg/ml and a minimum inhibitory concentration (MIC) of 2-512 mg/ml, respectively, when both solvents were used [23].

Although both ethanolic and aquatic extracts revealed significant antimicrobial activity, the ethanolic extract's activity was stronger, indicating that ethanol has a greater capacity than water to dissolve active phytochemicals. Additionally, bacteriostatic activity in contrast to B. cereus, B. coagulants, B. stearothermophilus and Clostridium sporogenes has been reported for the aqueous extract of banana puree [24].

- **Antidiarrheal Activity:**

For the purpose of rehydrating children with acute diarrheal disease, an experimental trial was carried out to determine the efficiency of solution containing 50 gm. /L of plantain flour and 3.5 gm. /L of Nacl. 121 kids received WHO Oral Rehydration Solution, while 117 received plantain dredge based treatments. The plantain flour founded remedy worked well to treat acute diarrheal diseases' associated dehydration [25].

In a dual blind clinical trial, 62 schoolboys aged 5 to 12 months were informally assigned to receive a rice based diet holding either 250 gm./lit of green banana or 4 gm./kg pectin for 7 days or the rice food alone, with the aim of evaluating the healing properties of green banana against pectin in children with determined diarrhea. The amount of feces passed, the need for intravenous fluids and oral rehydration solutions, and the frequency and length of vomiting and diarrhea were all significantly decreased by green banana and pectin. Green bananas and pectin are beneficial for treating children at home as well as in hospitals when they have persistent diarrhea [26].

- **Antiulcerogenic activity:**

According to research done on albino rats and guinea pigs with ulcers brought on by aspirin, indomethacin, phenylbutazone, prednisolone, cysteine, and banana pulp residue (0.5 mg/kg orally two times daily for 3 days), banana pulp treatment not only reinforces mucosal resistance compared to the ulcerogens but also encourages remedial by cellular proliferation [27].

Alternative study found that albino rats given banana pulp 0.5 gm./kg two times every day aimed at three days had significantly higher levels of total carbohydrates in their gastric mucosa, significantly minor levels of gastric juice and protein, and significantly higher levels of entire carbohydrates and the carbohydrate-to-protein ratio in their gastric juice [28].

- **Anti-allergic activity:**

According to studies done on RBL-2H3 cells, ripe Musa sapientum pulp water extract significantly inhibited antigen-induced degranulation with an IC 50 value of 13.5 [29].

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- **Antimalarial activity:**

In Comores, Ngazidja, a decoction made from Musa paradisiaca leaves combined with Ocimum americanum & Ocimum gratissimum is recycled to treat malaria. Nevertheless an in vitro study through a strain of Plasmodium falciparum resistant to chloroquine displays that this plant is ineffective against malaria [30].

- **Wound healing activity:**

Collected the methanol & aqueous extracts of the banana were tested for their ability to speed up the curing of wounds in rats. It was discovered that both extracts increased the levels of hydroxyproline, hexosamine, hexuronic acid and su-peroxide dismutase as well as the wound breaking power and abridged glutathione level. They likewise reduced lipid peroxidation, scarring, and the size of the wound. The plantain's antioxidant ability was said to be responsible for the effects [31].

- **Antihypertensive activity:**

It has been investigated how plantains affect albino rats' mean arterial blood pressure when deoxy-corticosterone acetate (DOCA) is used to elevate it. Rats that had previously received DOCA treatment reduced their mean arterial blood pressure to control levels by eating a plantain-based diet. Furthermore, when compared to controls, rats that had previously eaten plantain after receiving DOCA did not show any discernible variations in their arterial BP. Chronic consumption of plantains can reduce the elevated mean arterial blood pressure caused by DOCA in rats and also delay the beginning of DOCA-induced hypertension [32].

- **Hypoglycemic activity:**

A rabbit study revealed that Musa sapientum fruit had a sizable amount of antihyperglycemic activity. The results disclosed that the hyperglycemic peak and area below the glucose tolerance curvature remained considerably reduced. [33]. The hydroethanolic extract of Musa paradisiaca root has stayed establish to have a significant antihyperglycemic effect [34].

In rats with diabetes induced by alloxan, a study was conducted to determine the antihyperglycemic activity and influence of Musa sapientum floras on lipid peroxidation. For 30 days, albino rats were assumed oral doses of 0.15 to 0.20 & 0.25 gm. /kg of chloroform extract, which produced a substantial decrease in blood sugar and glycosylated hemoglobin and an rise in total hemoglobin. Reactive glutathione to thiobarbituric acid, superoxide dismutase, glutathione peroxides and catalase all decreased. Thus the research proves that antioxidant and hypoglycemic properties exist in banana flower extract [35].

- **Analgesic activity:**

In comparison to the vehicle-treated group, the analgesic activity of Musa sapientum leaf extracts at 400 mg/kg and 400 mg/kg, i.p., considerably sped up the reaction time in the hot plate method. The analgesic impact peaked after two hours [36].

- **Hepatoprotective activity:**

In CCl4 & PCM-induced hepatotoxicity models in rats, Musa paradisiaca's alcoholic and aquatic stem extracts were studied for their probable hepatoprotective properties. Pretreatment through alcoholic extract (500 mg/kg) more considerably and to lesser extent, the alcoholic extract (250 mg/kg) and aqueous extract (500 mg/kg), diminished the high intensities of serum enzymes such as serum glutamic pyruvic transaminase (SGPT), serum glutamicoxaloacetic transaminase (SGOT), alkaline phosphatase (ALP) & bilirubin levels. [37]

- **Vasodilatory activity:**

It was investigated how the plantain aqueous extract affected the rat aorta and portal veins' ability to contract. The extract was seen to relax the aortic rings that had been contracted due to noradrenaline and potassium chloride, and it completely stopped the portal veins from contracting on their own [38].

- **Hair Growth promoting activity:**

The unripe Musa paradisiaca fruit extract was studied for its capability to stimulate hair growth by measuring hair extent and perceiving follicles in a microscope in vehicle-control, 2%-minoxidil-treated, and extracts-treated rats. The findings propose that an unripe fruit extract as of Musa paradisiaca may be capable to promote hair development. [39]

- **Antilithiatic Activity:**

In a study, stem juice given orally to albino rats that had zinc discs implanted in their bladders to cause urolithiasis was found to be effective in preventing the formation of new stones as well as in dissolving existing ones [40]. In a clinical trial, 71 patients with urolithiasis received

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tablets made from Musa pseudo stem juice for four or more weeks. Twenty patients had no calculi found, while 43 patients passed out variable numbers of calcium oxalate calculi. Over the sequence of 14 weeks, when these patients were given a prophylactic dose, no reappearance of urolithiasis was seen in them [41].

The study used bleeding and clotting times to scientifically inspect the potential hemostatic result of Musa paradisiaca stem extract in guinea pigs. When the stem juice was added, it was noticed that blood coagulation and bleeding interval were both pointedly shortened (p 0.05). Since this is first account of the hemostatic special effects of Musa paradisiaca stem extract in animals, these findings are significant to present. These results demonstrated that Musa paradisiaca stem juice has hemostatic properties, which maintained its traditional use [42].

- **Hypolipidemic Activity:**

A study on the hypolipidemic properties of plantain inflorescence shoot was conducted. Rats served together cholesterol-free and cholesterol comprising foods demonstrated a significant reduction in serum cholesterol & triglyceride levels as well as triglyceride levels in the liver, and aorta after receiving pectin from the juice inflorescence stalk of Musa sapientum [43].

- **Antidepressant Activity:**

In an experiment, Musa paradisiaca fruit paste (20%, 10% and 5% w/w once daily for 15 consecutive days) exposed important antidepressant prospective in the forced swim test & tail suspension test. This drop in immobility time was pointedly resisted by baclofen (10 mg/kg, i.p.), prazosin (62.5 mg/kg, i.p.), and p-CPA (100 mg/kg, i.p.). The amounts of malondialdehyde and MAO-A were similarly reduced by Musa paradisiaca paste. These results point out that banana fruit's anti-depressant potential may be associated to its anti-oxidant, pro-serotonergic, adrenergic and monoamine oxidase inhibitory activity [44].

In the forced swim test & tail suspension test, Darji and Galani also noted a notable decrease in the immobility time following a 14-day of treatment with hydro alcoholic extract of Musa paradisiaca fruit (500 & 250 mg/kg, p.o.). The antidepressant potential of the fruit extract was enriched by bromocriptine mesylate (2 mg/kg, i.p.) and decreased by haloperidol (0.1 mg/kg, i.p.). The neurochemical analysis showed that a 14-day fruit extract treatment increased levels of norepinephrine, dopamine, and serotonin [45].

- **Cytotoxic and Thrombolytic Activity:**

By using the in vitro clot lysis method and brine shrimp lethality bioassay, respectively, it has been shown that the methanol extract of Musa paradisiacal root has significant cytotoxic and thrombolytic activity [46].

- **Anticonvulsant Activity:**

It is stated that a rhizome extract of M. paradisiaca cv. Puttabale with over-all phenolic (628.6 g/mg) and flavonoids (321.6 g/mg) abridged locomotor activity and minimized the effects of maximal electroshock and pentylenetetrazole-induced convulsions. In tests of muscle coordination and the forced swimming, the extract also decreased reaction times. According to the consequences, M. paradisiaca cv. Puttabale's corm extract has CNS-depressing and anticonvulsant properties, which may be due to the plant's phenolic and flavonoid content [47].

- **Anti snake-venom Activity:**

Musa paradisiaca stem extract was found to inhibit Phospholipase A2, myotoxic and hemorrhagic actions in vitro. The partial chemical representation of MsE revealed the occurrence of polyphenols & tannins, which are well-known to deactivate proteins without favor to their specific function [48].

TOXICITY STUDY:

By acute oral toxicity and uninterrupted dose 28-day oral toxicity as per OECD 425 & 407, individually this study evaluated the toxicity profiles of Musa paradisiaca pseudo stem juice. Over the course of study, changes in behaviour, food consumption, water intake, and weekly changes in body weight were all estimated. A biochemical study of serum samples was performed after the course of therapy. The results show that Musa paradisiaca L(pseudo stem) juice taken at a dosage level of 2000 mg/kg for 28 days is extremely safe and has not resulted in several appreciable modifications in body mass or metabolic indicators [49].

- **Hemostatic Effect:**

The study used bleeding and clotting times to scientifically examine the potential hemostatic effect of banana stem extract in guinea pigs. When the stem juice was added, it was perceived that

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- **Adaptogenic Effect:**

In stress-induced depression, anoxia stress and chronic variable stress models of rats, Ittiyavirah and Anurenj looked at the antistress effect of acetone extracts from unripe and ripe fruit peels of M. paradisiaca. The unripe fruit peel extract shown considerable antistress activity in the stress induced depression model, whereas mutually both extracts had a protecting effect in the other two models [50].

- **Mutagenic Effect:**

The mutagenic potential of M. paradisiaca fruit shell extract in mice was measured using the micronucleus and single cell gel electrophoresis (SCGE) tests. The assays revealed that peripheral blood leukocytes have the capacity to damage DNA at 1500 & 2000 mg/kg body weight [51].

- **Effect on Hormones:**

A study shows that how Musa paradisiaca peel extracts affected tissue lipid peroxidation as well as the stages of insulin, glucose and thyroid hormones in male rats. M. paradisiaca peel extract at concentrations of 0.25, 0.50, 1.0 & 2.0 microg/mL inhibited H (2) O (2)-induced lipid peroxidation in RBCs of rats in vitro. The maximum level of inhibition was reported at 1.0 microg/mL. M. paradisiaca (100 mg/kg) which is most effectively reduce hepatic lipid peroxidation during the in vivo experiment. M. paradisiaca expressively reduced the blood levels of T(3) and T(4) thyroid hormones while raising glucose levels [52].

II. CONCLUSION:

The banana plant has therapeutic qualities. There are numerous traditional medicinal uses for various parts of the banana plant. The roots and stems are used as tonics, antiscorbutic, and therapeutics for venous and blood disorders. A mixture of flower juice and curds is used to treat menorrhagia and dysentery. Numerous reports have been made on significant pharmacological actions in addition to traditional uses. It would be necessary to conduct additional research after reviewing the pharmacological studies mentioned in the review in order to approve the correct potential of Musa sapientum & Musa paradisiaca so that they may be clinically beneficial and economically viable.

CONFLICT OF INTEREST:

The authors declare no relevant conflicts of interest.

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