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MUSA SIKKIMENSIS, A PROMISING UNEXPLORED PLANT: A BRIEF REVIEW

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ABSTRACT

Banana is an edible fruit which is consumed worldwide. It consists of a variety of species which are regarded as traditionally used medicine. Various parts of banana belonging to the family Musaceae may have been used since ancient times to treat various diseases. Aqueous and alcoholic extracts of banana peels, flower and seeds have been used in traditional medicine due to their antihypertensive activity, antimicrobial activity, antidiabetic activity, anti-ulcer activity, antidiarrheal activity, nutritional value etc. Pharmacological activities of many species coming under the family musaceae are yet to be discovered. One such species *Musa sikkimensis* belonging to the family Musaceae is a native plant of Northeast India which is used by the indigenous people of that region as an ornamental fruit. It is used as a traditional medicinal plant which can be used to treat different diseases such as diarrhoea, parasitic infections, ulcers, diabetes etc. Different parts of the plant contain various phytoconstituents such as flavonoids, saponins, alkaloids, tannins. In vivo and in vitro studies have shown that musa species have anti-ulcer, anti-oxidant, anti-diabetic, anti-hypertensive, anti-diuretics and other activities.

KEYWORDS: musa, banana, darjeeling banana, Bankera.

INTRODUCTION

In developing countries, helminths are becoming a huge global health burden. Either due to nutritional disbalance or weak immune system, there has been a significant rise in such cases. WHO estimates that 1.5 billion human population are infected by this parasitic worms.[1]

Anthelmintic drugs are used to treat infections of humans and animals with parasitic worms. Many herbal plants with their footprints on traditional books or folklore system of medicines due to its medicinal properties remain neglected or very little researched.[1]

Musa sikkimensis, a wild banana, also known as Darjeeling banana, contains many phytochemical substances which can have different medicinal properties including anthelmintic activity. It was first collected by Joseph Hooker in Sikkim, but was not formally described until 1878 by Sulpiz Kurz, curator of the herbarium of the Calcutta Botanic garden.[2]

Common Names

Darjeeling banana, Bankera, tiang-moo-foo-goom,[2] Red tiger,[3] Sikkim's Hardy banana.[3]

Propagation and Cultivation

It can be propagated by suckers or offshoots and rhizome division methods.

Suckers grow from the base of the plant. Once it grows to 1-2 feet tall, gently it is digged around the base to expose the suckers**.** Carefully the suckers are separated from the parent plant. The separate suckers are then planted in well-draining soil, making sure to cover the roots and the soil is kept evenly moist.[4]

Rhizomes are the underground stems of the plant. The base of the plant is digged to expose rhizomes. The rhizomes are carefully divided into sections, and planted in well draining soil and the soil is kept moist. It grows in a warm environment i.e. 10-30^0 C. Soil must be very fertile and light. It requires a large amount of water for its growth. It is placed in partially shaded area to protect from direct sunlight.[4]

Plant Profile[5]

Kingdom	*Plantae*
Phylum	*Tracheophyta*
Class	*Liliopsida*
Order	*Zingiberales*
Family	*Musaceae*
Genus	*Musa*
Species	*Musa Sikkimensis Kurz*

Synonym

Musa hookeri, Musa paradisiacal var. *hookeri, Musa sapientum f. hookeri.*[5]

Botanical Description

A perennial herb that resembles a tree and has stems up to 4 meters tall that, after flowering, dies down to earth. This is a perennial plant whose stem consists of closely spaced leaf sheaths. New suckers, or offshoots, emerge from the base of dead stems. Male and female flowers are arranged in whorls along the stalk, with each banana containing firm, black seeds. It is regarded as one of the Musa species most resilient to cold.[6]

Figure 1: *Musa Sikkimensis.*

Flowers

It has red or reddish pink flower. Flowering normally occurs in the spring season, which is February-April or 9-12 months after planting. The image below consists of young flower and fruit of *Musa sikkimensis*.[6]

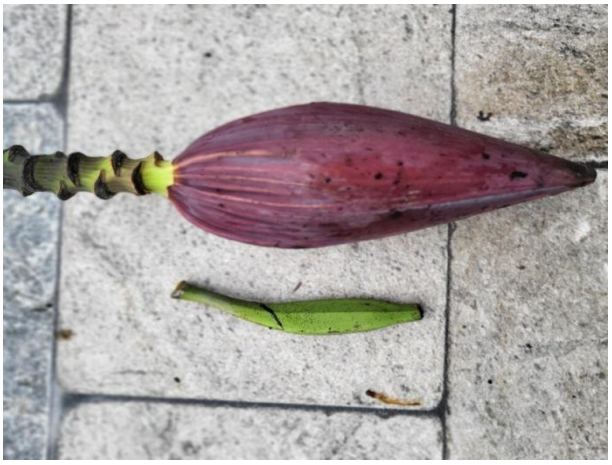

Figure 2: *Musa sikkimensis* flower.

Fruits

Maturation of fruits occurs in about 60- 90 days after the first flower is seen in the plant. One

plant consists of different “hand”. One hand can consist of two transverse rows of fruits. The quality of fruits depends on the length and thickness of the fruits, cluster arrangement, ripening evenness and if they are free from any defects.[6]

Figure 3: *M. sikkimensis* fruit (single)

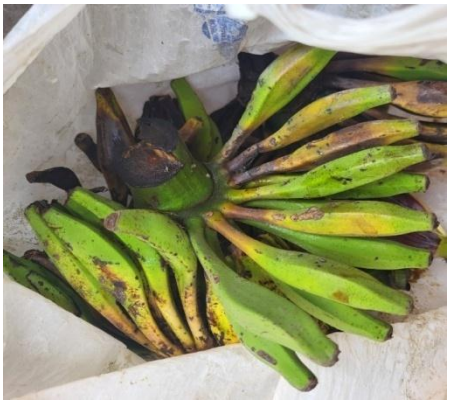

Figure 4: *M. sikkimensis* fruit *(bunch)*

Seeds

Seeds are dull black. They become brown when dried. Seeds are connected through a sticky latex inside the fruit. The quantity of seeds is 80-250per fruit.[6]

Figure 5: *M. sikkimensis* seeds

Figure 6: *M. sikkimensis* seeds

Leaves

The upper sides of the leaves are green when it's young while it contains a burgundy shade under the side. When the leaves mature, the upper side is green with burgundy stripes.[6]

Habitat

M. sikkimensis is found in the north-east region of India, particularly in Sikkim, Manipur and Darjeeling.[6]

Traditional uses

This species of banana is found in the wild. Tender inflorescence can be consumed as vegetables. In Sikkim, it is also used as an ornamental fruit. Native people of Sikkim consume this banana due to its medicinal properties.[6]

Phytochemical Composition of Musa species

Musa paradisiaca and Musa sapientum

Catecholamines like norepinephrine, serotonin, dopamine are found in the plant.[7] The pulp contains tryptophan, indole chemicals, and pectin.[8] The unripe pulp of plantains yielded a number of flavonoids and associated chemicals, including leucocyanidin, quercetin, and its 3-Ogalactoside, 3-O-glucoside, and 3-Orhamnosyl glucoside. The fruit pulp of *M. paradisiaca* and *M. sapientum* contains serotonin, norepinephrine, tryptophan, indole compounds, tannin, starch, iron, crystallisable and noncrystallisable sugars, vitamin C, B-vitamins, albuminoids, lipids, and mineral salts. From *M. sapientum*, carbohydrates have been extracted. The pulp and peel of *M. paradisiaca* have been used to isolate cellulose, hemicelluloses, arginine, aspartic acid, glutamic acid, leucine, valine, phenylalanine, and threonine. From the flower of *M. paradisiaca*, the following metabolites have been isolated: 1,1-dimethylallyl alcohol, syringin, (6S, 9R)-roseoside, benzyl alcohol glucoside, (24R)-4α, l4 α,24-trimethyl-Sacholesta-8,25(27) dien-3β-o1.[9]

Musa acuminate

M. acuminate is known to contain pelargonidin, peonidin, delphinidin, myricetin glycoside, myricetin-3-O-rutinoside, and malvidin. The plant has been shown to contain rutin, dopamine, kaempferol-3-Orutinoside, naringenin glycosides, and N-acetyl serotonin. Higher concentrations of lignin, hemicellulose, cellulose, polyphenols, flavonoids, total and insoluble dietary fiber, lipids, proteins, and minerals were discovered.[10]

Musa Balbisiana

M. balbisiana has a high alkalinity level due to its significant potassium and chloride buildup, which may have therapeutic use.[11]

Different sections of *M. balbisiana*colla provide flavonoids, polyphenols, tannins, monoterpenoids, sesquiterpenoids, quinones, and saponins.[12]

The peels of *M. balbisiana* fruits includes additional carotenoids like lutein and lycopene in

addition to α-, β-, and β-cryptoxanthin.[13],[14]

Ferulic acid, polyphenols, and C16 and C18 fatty acids are produced from *M. balbisiana* seeds.[15]

Pharmacological Activities of Other Musa Species

1. Anti- Diarrhoeal Activity

M. paradisiaca and *M. sapientum* were found to be effective in bacterial dysentery. Additionally, studies on critically ill patients receiving enteral feedings have shown that banana flakes are an excellent treatment for diarrhoea. Children with diarrhoea responded very well to the green banana diet's antidiarrhoeal properties.[16]

2. Anti- Ulcer Activity

In order to ascertain the efficacy of *M. paradisiacal* against this consequence, a study evaluated the ulcer index, gastric wall mucus, pH of gastric juice, and volume of animals that were induced with ulcers. The findings showed that bananas had a notable anti-ulcer effect. Tepal and peel extracts were found to prevent ulcers caused by pylorus ligation with indomethacin by 68.80±20.53 and 43.22±14.82%, respectively, according to the data. Furthermore, there was a decrease in the volume of gastric juice and a rise in mucus on the stomach wall in both the tepal and peel extract-treated groups. The study found that extracts from banana tepal and peel could prevent the formation of ulcers by fortifying the stomach mucosa.[17]

3. Anti- Oxidant Activity

The ß-carotene bleaching method, 1, 1-diphenyl-2-picrylhydrazyl (DPPH) free radical elimination, and the thiocyanate method were used to assess the antioxidant behavior of the extracts. Water extracts had a strong antioxidant property and their antioxidant activity was similar to that of synthetic antioxidants like butylated hydroxyanisole and butylated hydroxytoluene. Studies were conducted to examine the antioxidant properties of crude extracts from green bananas and yellow peels. The findings showed that the green peel extract of *M. sapientum* and *M. paradisiaca* exhibited more significant activities at different solvent extraction temperatures than the yellow peel extract.[18],[19]

4. Anti-Diabetic Activity

Rats with normal glucose concentrations that were consistently fed glucose at a rate of 2 g/kg

were used to assess the oral glucose tolerance of peels from *Musa sapientum* (EMS), *M. paradisiaca* (EMP), *Musacavendish* (EMC), and M. acuminata (EMA). Mice given 200 and 400 mg/kg of EMA and 500 and 1000 mg/kg of EMC were found to have a substantial anti-hyperglycemic effect ($p<0.01$) in this investigation. Furthermore, blood glucose levels significantly ($p.<0.01$) decreased when administered with both EMS (200mg/kg, p.o.) and EMP (500 mg/kg, p.o.).[17]

5. Anti-hypertensive Activity

Osim and Ibu (1991) subsequently discovered that a diet high in bananas could both lower mean arterial blood pressure and prevent it from rising in rats injected with desoxycorticosterone acetate (DOCA). Ripe banana pulp has an antihypertensive effect on hypertensive rats caused by deoxycorticosterone enantate, according to Perfumi et al. (1994). Bananas' high tryptophan and carbohydrate content may be responsible for this impact, as these nutrients increase serotonin levels and have a serotonin-mediated natriorexic effect. However, Orie (1997) discovered that serotonin produced a contraction as opposed torelaxation in isolated rat aortic rings. The aqueous extract of ripe *M. paradisiaca* fruit exhibited a concentration-dependent hypotensive effect.[16]

6. Diuretic Activity

In a rat study, ash from the peel of *M. sapientum* demonstrated increased excretion of K+ and other electrolytes, along with a higher urine volume than normal saline. This diuretic effect is likewise produced by successive ethanolic extract.[20]

It is recognized that phytochemicals including terpenoids, flavonoids, and saponin are what cause this impact.[21],[22],[23]

7. Analgesic Activity

The analgesic effectiveness of the plant's aqueous extract was evaluated using the hot plate method and the writhing test in mice. The acetic acid-induced writhing method can be used to find analgesic effects that act peripherally, whereas the hot plate approach can be used to identify analgesics that work centrally. By releasing endogenous molecules that in turn activate the pain nerve terminals, acetic acid causes analgesia. Acetic acid is used as a writhing syndrome inducer. In every animal that was studied, the aqueous extract of *Musa paradisiaca* showed analgesic action. This suggests that two components may be present to account for this effect, one functioning centrally and the other via a peripheral channel. Based

on the aforementioned research, the aqueous extract has proven to be efficacious at varying doses.[24]

8. Augmenting action on skeletal muscle contraction

The augmentation activity in skeletal muscles was investigated using an extract from the juice expressed from the stem of the plantain banana tree (*Musa paradisiaca sapientum L., var. paradisiaca*). Skeletal muscle twitch enhancement was brought about by this extract. The mechanism of action was investigated using the mouse hemi-diaphragm preparation. Both directly triggered twitches and potassium-induced (K+) contractures were enhanced by the extract.[25]

9. Anti-allergic Activity

The aqueous extract of ripe *M. sapientum* pulp has demonstrated a substantial antiallergic action on antigen-induced degranulation in RBL-2H3 cells, with an IC50 value of 13.5±2.4.[26]

10. Mutagenicity

It was reported that the mutagenic potential of *M. paradisiaca* fruit peel extract in mice was examined using the single-cell gel electrophoresis (SCGE) and micronucleus assays. Peripheral blood leukocytes at 1500 and 2000 mg/kg body weight were shown in the experiments to possess DNA-damaging abilities.[20]

11. Anti-cancer Activity

Numerous investigations have revealed the anticancer and anti-proliferative properties of parts of *M. balbisiana*. A significant amount of cytotoxicity was demonstrated by the plant when it came to human normal endothelial cells and four cancer cell lines: MCF-7 (human breast cancer), HeLa (human cervical carcinoma), HT-29 (human colorectal adenocarcinoma), and HCT 116 (human colorectal carcinoma). IC50 values varied between 5.25 and 114.08 µg/ml.[27]

The colon cancer cell line HT-29 was shown to exhibit the highest level of activity. The proportion of viable cells stayed at 3.74% and 3.94% at concentrations of 1000 and 500 µg/ml, according to quantitative analysis of *M. balbisiana* peel extract's action on T-47D cells.[28]

12. Hepatoprotective Activity

Hepatoprotective properties have also been discovered for certain parts of *M. balbisiana*. According to Zakaria et al., the basal diet supplemented with dried banana fruit or banana peels at the two studied levels (5% and 10%) led to a significant increase ($P<0.05$) in the concentrations of high-density lipoprotein and insulin activity and a significant decrease ($P<0.05$) in the elevated levels of serum glucose, urea, uric acid, creatinine, triglycerides, total cholesterol, low-density lipoprotein, very low-density lipoprotein, aspartate aminotransferase, alanine aminotransferase, and alkaline phosphatase levels as compared to the control diabetic rats.[29] The current study shows that when given to diabetic hepatotoxic rats, banana fruit and peel exhibit hypoglycemic and hepatoprotective properties. Likewise, it has been reported that *M. balbisiana* var. vittata whole plant extract has hepatoprotective effect in CCl4-induced hepatotoxicity. Likewise, it has been observed that the entire plant extract of *M. balbisiana* var. vittata exhibits hepatoprotective properties when CCl4 induces hepatotoxicity in rats.[30]

13. Antispasmodic Activity

From recent studies it has been decumented that Musa paradisiaca aqueous extract (in a dose of 4 and 2mg/mL) has exhibited antispasmodic activity and showed concentration dependent reduction in the contraction of chicken ileum induced by acetylcholine.[31]

CONCLUSION

Banana i.e. *Musa sikkimensis* is a wild fruit having wide-range of disease management activities. Traditionally as well as scientifically various species of Musa has been found to have potential role in disease cure. In light of the review, it can be inferred that *M. sikkimensis* possesses significant advantageous biological activities. Further investigations can confirm these findings in a therapeutic context.

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