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A REVIEW ON BANANA BLOSSOM: THE HEART OF BANANA

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ABSTRACT

The banana plant is treelike a perennial herb. It's a herbaceous flowering plant belonging to the genus *Musa* and the family *Musaceae.* It has an edible fruit and plant has no much use after harvesting the fruits, but researchers say that even the other parts of the plant like stems, leaves, and flowers have nutritional and medicinal uses. This review focuses mainly on the banana flowers and the ethnobotanical uses states that the banana flower is used for various activities like immunomodulatory potential, anthelmintic, antiulcer, antioxidant, anticancer, antibacterial, antidiabetic, and anti HIV activity. Apart from the medicinal uses the flower is also used as vegetable by the people all over the world, hence for this reason Banana flowers are known as Banana hearts. The aim of this review is to explore the pharmacological studies on banana blossoms. This paper also focuses on the nutrition value and phytochemical constituents of the banana blossom which is helpful for developing new generic medicines for certain uncontrollable diseases.

KEYWORDS: *Musa acuminata*, banana blossoms, bioactive constituents, nutrition value.

INTRODUCTION

The ecosystem is comprised of flora and fauna. The plants in this flora are evaluated for bioactive principles which can be used to treat various uncontrolled diseases by developing a new generic medicine. Musaceae is one such plant family which has wide importance in terms of its fruits, flowers, leaves, stem etc.[1] Banana, an antique fruit crop known as "Apple of Paradise" plays an important and interesting roles in the history of human civilizations.

This plant is indigenously grown in Tamilnadu and Kerala in India.[2] Banana plant is ideal when it comes to no wastage policy. All the parts of the plants are useful, even the hazardous waste pseudostem can also be used to make yarn, fabric, apparel as well as fertilizers, biochemicals, fish feed, paper, handicrafts, candy, pickles, etc.[3] As the plant is a source of food, beverages, medicines, flavorings, fermentable sugars, fragrance, clothing, smoking material and other religious uses. Due to this, the plant has attained its importance within in the pacific societies.[4]

Wide variety of banana plant species can be found throughout the world. In musaceae family there are 2 genera (*Musa* and *Ensete*) and 42 different species, among this 42 species 32 of them belongs to *Musa* genera. Till now 1200 varieties of bananas have been identified.[5] But India has limited number of species like *Musa acuminata* Colla, *Musa oranta*, *Musa sapientum*, *Musa balbisiana* Colla, *Musa itinerans* Cheesman, *Musa nagensium* Prain, *Musa aurantiaca* G. Mann ex Baker, *Musa sikkimensis* Kurz and *Musa cheesmani* N. W. Simmonds and *Musa flaviflora*.[1]

Among these species *Musa acuminata* (wild banana) is one of the rarest species, which is generally found growing in the hilly areas in between the rocks. This plant in an unfavourable microenvironment like inadequate water supply, light, temperature and humidity, nutrition's and mineral, etc., was found to behave like epiphytes. *M. acuminata* was found to grow on the trunk of *Azadirachta indica* in a microenvironment.[6]

Musa acuminata plant has various parts like fruits, flowers, stem, leaves, roots etc. Each part has its own specific nutritive value, uses and bioactive principles.

Fruit

Fruits are the edible parts of the plants and are rich source of energy, vitamins (A-carotene, B- thiamine, niacin, riboflavin, B6, C-ascorbic acid, D) and minerals (Potassium, Magnesium, Copper, Boron, Calcium, Iron and comparatively less amount of sodium).[7] The fruits of *M. acuminata* also contain sugar, fat and proteins. Their won't be much variation in the proteins and fat content of the fruit pulp in the ripe and unripe condition, whereas sugar content was found to be more in the ripe condition.[8] The fruits are generally used to treat blood pressure (in ripe condition).[9] diabetes (when cooked with other vegetables or as a spice in food or by taking one fruit daily in the morning)[10, 11] and anemia (when eaten in raw condition),[12] In addition to this, there are other such uses like immunity and energy booster,

to treat Alzheimer's disease and heart burn, reduce cholesterol level etc.[13] The bioactive compounds of the fruits were found to vary with ripe and unripe condition and also with ethanol, methanol, chloroform and dichloromethane extracts. But in general, the phytoconstituents of fruits are alkaloids, glycosides, tannins, saponins, phenolics, flavonoids, fatty acids, carotenoids.[12, 14, 15, 16, and 17]

Sap

Sap is generally used to treat fever when consumed in the extract form.[18] These saps contain flavonoids (apigenin, myricetin, kaempferol, quercetin), dopamine, N-acetylserotonin, caffeoylquinic acid and hydrocinnamic acid in ethanol extract.[19]

Peels

Peels of banana fruits are generally used in the water treatment to remove nitrites from the drinking water and also has antifungal and antibacterial property.[20] It also has industrial applications as bio-sorbents, bio-fuel production, pulp and paper, cosmetics, organic fertilizers, energy related activities, environmental cleanup and biotechnology related processes.[21, 22, and 23] The fruit peel shows variable amounts of chemical constituents like glycosides, tannins, phenolics, saponins, flavonoids and terpenoids in hexane, acetone, methanol, ethanol and waters extracts.[24,25]

Root

The roots of *Musa acuminata* is used to treat HIV/AIDS or other sexually transmitted diseases, sores on genital parts,[26] piles, snake bites, prevent conception[27] and also used to induce labour.[28] The main use of root is that it acts as an anthelmintic drug.[29] The methanol extract of roots shows the presence of 2-hydroxy-9-phenylphenalen-1-one (Anigorufone).[30]

Leaves

The banana plant as such is well known primarily for its fruits and secondarily for wide use of leaves, religious these leaves are used to serve food. The leaves are used for dressing wounds & blistered skin and also used to treat asthma & wheezing.[31]

These leaves were found to have phenolics and tannic acid from ethanol, methanol, acetone and petroleum ether extracts[32] & alkaloids, steroidal lactones, cinnamic acid and ferulic acid from them powdered methanol extract.[33,34]

Stem

The plant stem and the banana flower of inflorescence is a rich source of dietary fibers and due to this they are having wide applicability in textile industry, along with is they are also used to relieve kidney stones and used to treat tuberculosis & other respiratory diseases. Hence consumed as a vegetable throughout the world. It is also used in the field bio-film, paper industry, bio-plastic, bio-electricity in the agro-industry, pharmaceuticals, bio-medical and bio-engineering aspects etc.[30] The core of the stem or pseudo-stem was found to contain mainly carbon, hydrogen and nitrogen.[31]

Banana blossom

The plant stem upon maturing gives rise to a bunch of rolled leaves and then protrudes as a dark purple bud that are elongated and oval shaped which is known as inflorescence or flower or banana blossom. Blossom has 2 parts mainly:

- Outer sheath like substance which is reddish to purple in color referred as Bract.
- Inner small tubular-toothed whitish flowers that are arranged along the floral stacks are known as Florets.

Every time when one banana blossom is produced, banana stem is also co-produced along with it. After harvesting the fruits from the stem the flowers and the other byproducts of the banana plants are usually thrown down.

Bract

The *Musa acuminata* bracts are of generally purple or red coloured (varying from bright red to dark violet), but sometimes they may be yellow at the extreme tip and outer surfaces; and are convolute which generally overlap at the extreme tip. Bracts are more or less glaucous, faintly ribbed longitudinally, with inner surface paler, light red or yellowish. The shape of the bract is generally lanceolate or narrowly ovate and sharply tappers towards the end with acute apex. The bract shoulders are usually high (ratio<0.28) and the curlings of the bracts look like reflex and roll back after opening.[34] Bracts lift from the first hand in 3 to 10 days which will shed soon and will give rise to a fully grown fruits in a cluster,[35] only one bract lifts at a time and it revolute on fading. The bracts are generally used as feed for cattle's but it can also be used to treat hypertension when taken in the form of decoction for 3times a day.[36] The bracts were found to contain certain bioactive constituents like alkaloids and cycloglycosides in petroleum ether extract[37] and flavonoids in ethylacetate extract.[38] Methanol extract

showed various constituents like alkaloids, glycosides, saponins, terpenoids, tannins, flavonoids, phenols, steroids and coumarins, whereas aqueous extracts has coumarins and phenols but chloroform extract didn't show any bioactive principles.[39]

Florets or flowers

The flowers of the banana plant are one of the widely consumed vegetable in several cuisines in Asian countries especially in Malaysia.[40] The male flowers are generally creamy white whereas the stigma is orange or rich yellow in color. The basal flowers has a female hands that varies from 1-10 in numbers that are arranged in 2 rows per bract and male flowers are occasionally more in number around 20 florets arranged in 2 rows per bract and are found in the upper hands. The compound tepal is about 2.5 cm long that is white, yellowish or slightly purple with white or yellow tip and lobes, and consists of free tepals, which are translucent and are about half in length of the compound tepal. It has pale green, yellowish green, or purplish ovaries that are either glabrous or with a few fine hairs near the base. Male buds in advanced blooming stage are ovoid to turbinate. The stamens and perianth has same length and their anthers usually turn pink before dehiscence.[34] South Asians and Southeast Asians use banana flowers either as raw or steamed with dips (as vegetable) and also used in curries, soups, fried foods etc. The flavor of the flowers resemble like artichokes.[41]

100g of banana flower offers lot of nutritious benefits like 51 kcal, 1.6g of Protein, 0.6g of Fat, 9.9g Carbohydrates, 5.7fgof Fiber, 56mg of Calcium, 73.3mg of Phosphorous, 56.4mg of Iron, 13mg of Copper, 553.3 mg of Potassium, 48.7mg of Magnesium and 1.07mg of Vitamin E.[41] The flowers are widely used to treat Allergies, infections, bronchitis, dysentery, Joint pain and better Blood circulation.[29, 42] Apart from this the flowers are also used to manage diabetes and anemia, helps nursing mothers, boosts mood and reduces anxiety and helps to reduce free radical activity and menstrual bleeding.[41] The major bioactive principles that are found in the methanol extract of flowers were glycosides, tannins, saponins, phenols, steroids and flavonoids.[43]

Some of the activities that have been proved on banana blossoms were

1. Anticancer activity

The ethanol extract of the banana flower (*Musa paradisiaca*) was screened for an invitro anticancer activity on cervical cancer cell lines (HeLa, CHO cells and normal human lymphocytes). The phenol in the bioactive fraction was found to induce apoptosis in the treated HeLa cells more profoundly than CHO cells with an IC50 value of 20µg/mL. MTT

assay was used to evaluate antiproliferative effects. TLC and LC-MS was used to purify the extracts.

From this study it is clearly understood that ethanol extract of banana flowers can be used to prepare generic medicines to treat cervical cancer.[44]

2. Antidiabetic activity

Presence of pharmacologically active ingredients in the *Musa paradisiaca* flower extract shows antidiabetic activity. Alloxan and streptozotocin were induced to animal models for diabetic studies. Streptozotocin induced diabetes exhibits many features similar to human diabetes mellitus which is cytotoxic to β-cells of the pancreas. The flower extract showed a siginificant decrease in the levels of insulin and C-peptide in streptozotocin induced diabetic rats. Acute oral toxicity studies reveal the non-toxic nature of flower extract and there was a significant reduce in the levels of blood glucose, glycosylated hemoglobin, urea, uric acid and creatinine in the diabetic rats treated with the flower extracts on oral administration of 200mg/kg body weight for 30days. This proves that the *Musa paradisiaca* flowers extracts are potent hypoglycemic factor on comparing with glyclazide, a known hypoglycemic drug.[45]

3. Antioxidant activity

Antioxidant activity on 2 different varieties of banana flowers (*Musa baxijiao* and *Musa paradisiaca*) were studied by DPPH radical scavenging activity, ABTS radical scavenging activities and inhibition of lipid peroxidation in egg lecithin through the formation of thiobarbituric acid-reactive substances (TBARS). These assays have been extensively used as models to characterize peroxidative damage in biomembranes. The EC50 values are calculated for these methods and compared with both the banana flower extracts, where Baxijiao flower extract showed a better antioxidant activity than Paradisiaca with much lower EC50 values. After complete analysis an additional antioxidant concentrations of polyphenols and flavonoids were found to be higher in Baxijiao variety due to which it is used as a good dietary supplement or as a food additive.[36]

4. Antimicrobial activity

The methanolic flower extract of Musa acuminata showed good antimicrobial activity against various pathogenic microorganisms like *Escherichia coli, Micrococcus sp, Salmonella sp, Proteus mirabilis, Staphylococcus aureus, Bacillus subtilis, Candida albicans, Aspergillus*

niger with MIC values ranging between 1.56 to 12.5 mg/mL and zone of inhibition ranging from 12 mm to 22 mm.[43]

CONCLUSION

From this study it is concluded that the whole banana plant can be used as food, feed, pharmaceuticals, packaging and many other industrial uses. *Musa acuminata* variety is having a great healthy benefits as per ethanobotanical uses but scientifically this plant can be choose to prove the pharmacological activities on different plants of the plant. Out of all parts banana blossoms shows a good antimicrobial property which can be used further to prepare a generic medicine by Nano-technological approach.

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