

Banana Stem Extract-Its Reflections In General And Oral Health

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Abstract:

Ayurveda And Other Indian Literature Reveled The Use Of Herbs In Treatment Of Various Human Illness. Its Usage Is Of Increasing Interest Due To The Efficiency And Superiority Of Actions Due To Phytoconstituents In Herbs And Undesirable Side Effects Of Modern Medicine. Though, The Mechanism Of Action Of Most Herbal Medicines Has Not Been Fully Understood, The Knowledge And Experience Obtained From Their Traditional Use Over The Years Should Not Be Ignored. One Such Medicinal Plant, Which Lacks Scientific Scrutiny, Is. Banana Plant. So, The Present Review, Exploring The Possible Pharmacological Activities Of Banana Stem Extract For General Health As Well As Oral Health Applications.

Key Word: Banana Stem, Oral Health, Phytodentistry, Herbal Dentistry, Musa Paradisiaca

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I. Introduction

In many developing countries and geographical areas, traditional medicine is found to be the only accessible and affordable mode of available treatment. Medicinal herbs are considered as the main component of this treatment modality¹ and consumption of them protects and heals a number of ailments.² They have been the principal treatment strategy in prehistoric times until the discovery of synthetic drugs in the nineteenth century. About 40% of available drugs are derived from herbs and about half of the world's best-selling pharmaceutical preparations are derivatives of natural products.³

Ayurveda and other Indian literature revealed the use of plants in the treatment of various human illnesses. Herbal usage is of increasing interest due to the efficiency and superiority of actions due to phytoconstituents in herbs and the undesirable side effects of modern medicine.⁴ However, scientific evidence should be there in order to make this traditional system acceptable to modern medicine. Mechanism of action and active principles behind their use should be made clear. Though, the mechanism of action of most herbal medicines has not been fully understood, the knowledge and experience obtained from their traditional use over the years should not be ignored.⁵ One such medicinal plant, which lacks scientific scrutiny, is. banana plant.

Banana plant or plantain is herbaceous,⁶ perennial, monocotyledonous flowering plant and it is considered as one of the earliest crops grown in the history of agriculture.⁷ It comes under the family Musaceae, belongs to plantae kingdom and the genus is Musa⁸. Most edible bananas and plantains are descended from a wild ancestor, Musa acuminata and Musa balbisiana⁹. Depending on the pattern of consumption, Carolus Linnaeus, classified banana plants into two species: Musa sapientum for dessert and Musa paradisiaca for plantains.¹⁰ Subsequently, more species were added. Musa species are differentiated according to "ploidy" the number of chromosome sets they contain, and the relative percentage of Musa acuminata (A) and Musa balbisiana (B) in their genome. Most familiar banana plants are triploid hybrids – [(AAA), (AAB), (ABB)]. Diploids, [AA, AB, BB and tetraploids [(AAAA, AAAB, AABB, ABBB)]¹¹

Banana plant or Musa paradisiaca start to develop from a layer called corm (swollen stem base that is modified into a mass of storage tissue) and the trunk part is referred as false stem or pseudo stem. The tubular structured pseudo stem is very fleshy with water as its major composition, has a soft central core and is tightly packed with sheaths. The stem grows normally 5 to 7.6 meters tall and support the whole plant.²

From ancient time itself, different parts of Musa paradisiaca were used for many traditional treatment purposes like antidepressant, antibacterial, antihypertensive, antiulcerogenic urolithiasis, laxatives, anthelmintic, analgesic, antifungal, constipation, wound healing, fevers, burns, diarrhoea, inflammation, pain relief and anti-venomous for snake bites.^{12,13} Almost all parts of Musa paradisiaca were used for medicinal purposes. Raw flowers are used in treating ulcers bronchitis, dysentery, menorrhagia and cooked flowers are used to treat diabetes.^{14,15}

Mature leaves are used to treat inflammation, diarrhoea, headache and rheumatism and tender leaves are placed as poultices on burns.^{16,17,18} Ashes of unripe peel and leaves exhibited astringent property and they have been used for dysentery, diarrhoea and for treating malignant ulcers.¹⁹ The root portion is administered for anthelmintic problems, blood disorders, digestive disorders, dysentery and venereal diseases.^{20,21} Stem juice of fruited plant is used for treating diarrhoea, dysentery, cholera, otalgia, haemoptysis. The sap of plant is having astringent property and it was used for and for topical application for haemorrhoids, insect bites. It also used for treating hysteria, epilepsy, leprosy, fevers, hemorrhages, dysentery and diarrhoea.^{22,23} Peel and pulp of fully ripe bananas showed antifungal and antibiotic properties. Banana seed mucilage from certain varieties of plants was given in cases of catarrh and diarrhoea in certain parts of India.²⁴

In the present review, we are focusing on banana stem and exploring its pharmacological activities applicable to general health as well as oral health.

II. Pharmacological Actions on General Health

Antioxidant Activity

Nataraj Loganayaki et al in 2010 compared antioxidant activity of *Musa paradisiaca* (stem and flower) and *Rivea hypocrateriformis* or Mustai (leaves, stem, and flowers). They found that the antioxidant potential of the extracts was well established with their DPPH and ABTS radical scavenging activities.²⁵ Jayamurthy et al., studied the free radical scavenging capacity and antioxidant activities plantain (methanolic extracts of inflorescence and stem core) in terms of total phenolic content, 1, 1-diphenyl-2-picrylhydrazyl (DPPH) radical scavenging activity (RSA), superoxide RSA, metal chelation and total reducing power. The results from the study showed that the methanolic extracts of inflorescence and stem were able to effectively scavenge the free radicals.²⁶

Wound healing activity

Mokbel et al., 2005 conducted study on rats to evaluate the wound healing activity of *Musa paradisiaca*. The animals were fed with graded dose of (50-200 Kg/day) of *Musa paradisiaca* extract (aqueous and methanol) orally for a period of 10-21 days. When compared with the control group, the extracts showed increased wound breaking strength and levels of hydroxyl proline, hexuronic acid, hexosamine, superoxide dismutase, reduced glutathione in the granulation tissue and decreased the percentage of wound area, scar area.²⁷

Amutha K et al explored the phytochemical, antibacterial and wound healing activity of *Musa paradisiaca* (methanolic stem extract) and reported that extract had high quantities of glucosides, tannins and alkaloids, saponins, flavonoids and presence of phenols in moderate quantities. The extract showed antibacterial activity against *Pseudomonas aeruginosa* and *Staphylococcus aureus*. They conducted studies on Wistar albino rats. The burn wound was created and the progressive changes were monitored every day after application of methanolic extract. Greater healing activity was observed with methanolic extract of stem when compared with control.²⁸

Antilithiatic activity

Kalpana Devi et al²⁹ reported that *Musa paradisiaca* stem juice is effective as antilithiatic agent in experimental urolithiatic rats. Stone forming rats have a significant elevation in the activities of two oxalate synthesizing enzymes - Glycollic acid oxidase and Lactate dehydrogenase. Deposition and excretion of stone forming chemicals in kidney and urine were also increased in these rats. When *Musa paradisiaca* stem extract was given by oral route at a dosage of 1.5 ml/ rat/day, there is decrease in these enzyme activities and the level of crystalline components. There was decrease in activities of urinary alkaline phosphatase, lactate dehydrogenase, γ -glutamyl transferase, inorganic pyrophosphatase and β -glucuronidase in calculogenic rats.

Gopakumara pillai conducted a human study in patients with urolithiasis to check the effectiveness of banana stem. Juice of pseudostem core of *Musa Paradisiaca* and *Musa sapientum* were given as medicine to treat kidney stones. Majority of patients passed out calculi of varying size after consuming the juice for two weeks. Recurrence of stone formation was also prevented by this treatment suggesting that *Musa* stem juice is quite effective in curing urolithiasis, especially of the calcium oxalate variety.³⁰ Prasobh et al., 2014 studied the effect of *Musa* AAB species in the management of renal calculi under invitro condition and found that a significant decrease in the size of kidney stone. According to authors, possible mechanism of actions may be due to the presence of organic constituents like β -sitosterol, quercetin, tannins, saponins and inorganic constituents like magnesium, potassium and nitrate in stem juice of *Musa* AAB.³¹

Report of Joy et al., suggested that the stem juice of *Musa paradisiaca* is more effective in preventing recurrence of renal stone. Though, surgical treatment & extracorporeal shock wave lithotripsy are effective, they may cause some problems like long term renal damage, hypertension and reoccurrence of stones. So, herbal drugs form like *Musa paradisiaca* stem juice are found to be effective with no side effects.³² Animal study by Tirumala et al., 2013 tried to evaluate the effectiveness of oral administration of aqueous extract of *Musa paradisiaca* stem core juice on ethylene glycol and ammonium chloride induced urolithiasis in rats for 28 days. They found a significant reduction in stone level.³³

Kailash and Varalakshmi³⁴ studied the influence of *Musa sapientum* stem extract on glycolic acid oxidase (GAO) and lactate dehydrogenase (LDH) enzymes in liver tissues of sodium glycolate-induced hyperoxaluric rats. A significant reduction in effect of GAO was seen in the extract-treated rats compared to that of the glycolate-fed rats. There was elevation in LDH in glycolate administered rats. Another animal study by Poonguzhali and Chegu,³⁵ 1994 reported that in the rats treated with aqueous stem extract, urinary oxalate excretion was remarkably reduced as compared to controls. The extract exhibited reduction in excretion level of urinary oxalate, glycolic and glyoxylic acid and phosphorus.

According to Aishwarya M H et al, banana stem extract contains bioactive compounds like flavonoids, alkaloids, terpenoids, tannin as the secondary metabolites. These bioactive compounds are responsible for diuretic action which helps to detoxify the body and responsible for de-crystallization of stones.³⁶ Abu Zarin et al conducted a study on potential anti-urolithiatic activity of *Musa pseudo-stem* extracts from different species and reported that all extracts were effective in treatment for kidney stones disease.³⁷ Another study by S. Vanitha et al reported that a 6.9 % decrease in the stone weight in presence of raw stem juice. They also suggested that as banana stem juice has anti-urolithiatic property, regular consumption of banana stem can reduce the chances of kidney stone formation.³⁸

Anti-snake venom activity

According to Borges et al, stem juice of *Musa paradisiaca* showed neutralizing capacity of *Bothrops jararacussu* and *Bothrops neuwiedi* snake venoms by invitro methods.³⁹ The phospholipase A2 (PLA2) and hemorrhagic activities induced by the venom was inhibited by the extract as it forms unspecific complex with the venom protein. But in- vivo study showed activity of the extract in mice was not significant to protect against the venom.

Hepatoprotective activity

Sanjeev Kumar et al. conducted an animal study to investigate the hepatoprotective activity of *Musa paradisiaca* stem juice in rat models. Pre-treatment with alcoholic extract reversed the hepatic damage towards the normal and reduced the elevated levels of the serum enzymes like serum glutamic-oxaloacetic transaminase (SGOT), Serum glutamic pyruvic transaminase (SGPT), Alkaline phosphatase (ALP) and bilirubin levels.⁴⁰ Similar evidence of hepatoprotective activity was reported by Nirmala et al., 2012.⁴¹

Effect on muscular system

Banana plant stem juice was used as an arrow poison by tribesmen of Africa. Lee et al⁴² conducted an animal study on mouse hemi-diaphragm preparation model for evaluating the efficiency of *Musa sapientum* trunk juice as a neuromuscular blocker and reported to induce twitch augmentation in skeletal muscles. Nifedipine enhanced the augmenting effect of the trunk juice on twitches but shortened the time course of this action. Singh and Dryden,⁴³ reported that the stem juice of plantain banana tree (*M. sapientum* var. *paradisiaca*) has been found to induce contraction in skeletal muscles by enhancing excitation-contraction coupling and transmembrane Ca²⁺ fluxes. Later, Benitez et al⁴⁴ (1991) reported the trunk juice of *M. sapientum* var. *cavendishi* has muscle paralyzing effect in rat and it may be due to the presence of monopotassium oxalate present in the juice. Lyophilized, partially purified extracts enhanced and then blocked contractions of the mouse diaphragm. Potassium nitrate and magnesium nitrate was found to be the active components which were responsible for this effect.⁴⁵

Antidiabetic activity

Singh et al in 2007⁴⁶ reported that *M. paradisiaca* stem juice showed hyperglycemic activity. In 2011 Dikshit et al reported antidiabetic effect of stem of *Musa sapientum*.⁴⁷ Nguyen D et al⁴⁸ in 2017 investigated for the presence of phytochemicals with anti-diabetic potency of banana stem juice. They reported that inhibitory activity against α -glucosidase and α -amylase. Santosh Kumar Singh et al., conducted an animal study to evaluate the effect of *Musa paradisiaca* stem juice on blood glucose. In normal rats, the dose of 500 mg/kg bodyweight elevated blood glucose level (28.3%) after 6 hours of oral administration. In sub diabetic rats, the same dose produced a rise of in blood glucose levels (16.4%) within 1 hour during glucose tolerance test and in severe diabetic cases, a rise of 16% after 4 hours in fasting blood glucose levels. This proves the antidiabetic activity of *Musa paradisiaca*.⁴⁹

III. Pharmacologic Reflections on Oral Health

Hard tissue

Renal stones are part of a multifactorial disease and 85% of renal stone primarily contain calcium oxalate admixed with calcium phosphate in the form of apatite or brushite or occasionally uric acid.⁵⁰ The recent proposed mechanism of stone formation involves urinary supersaturation, nucleation, precipitation, growth, aggregation of crystals, and their retention in renal tubular epithelial cells with crystal matrix.

While looking at the formation process and mineral content that make up kidney stone and dental calculus, similar mechanism of stone and dental calculus formation was observed. The dental calculus percentage was significantly higher in patients with kidney stones. This can be due accumulation of the materials that make up the stone structure in the body and it indicate that kidney stones can form in patients with a high dental calculus density.⁵¹ Report of Davidavich E et al established a correlation between disturbed mineral metabolism and dental calculi in children with kidney diseases.⁵²

Idiopathic calcium renal stones and their relationship to dental calculi was studied by Shaimaa et al⁵³. They reported that there is a significant correlation between dental calculus accumulations and calcium renal stone formation. So, they gave importance to oral health in patients who reported with kidney stone problems and offered oral health preventive programs. Bulent Kati et al suggested that the formation of a visible stone, such as a dental calculus, can be considered as a predictor of stones such as kidney stone.⁵¹

Based on this evidence, there is a possibility that banana stem extract will be effective in treatment of dental calculus. So, it can be assumed that banana stem extract can be utilized as cheap and easily available anti – calculus/ calculus dissolving agent in dentistry.

Hiraide F et al proposed that some of the minerals found in saliva cause the formation of stones in the salivary glands.⁵⁴ Salivary sialoliths are predominantly composed of crystals comprising calcium and phosphorous, with small amounts of sodium, magnesium, chloride, iron, silicon, and potassium. Grases et al reported that patients with hydroxyapatite calculi exhibited significantly higher level of salivary calcium concentrations than healthy people.⁵⁵ Rakesh N. et al. reported that, when sialoliths and nephroliths compared, a high degree of elemental similarity was seen between them. So, they conclude that same drugs used for managing kidney stones can be considered for treating sialoliths also.⁵⁶ Thus, it can be alleged that banana stem extract can be used for conservative management of sialoliths.

Soft tissue

Mokbel et al.²⁷ and Amutha K et al²⁸ suggested that banana stem extract exhibited wound healing activity in animal studies. So, a proposed treatment modality for oral wound healing, especially oral burns and traumatic ulcer, stomatitis and even minor surgical wound management can be accomplished with banana stem extract preparations in future.

Many studies reported that banana stem extract was able to effectively scavenge the free radicals.^{25,26} This anti-oxidant effect can be utilized in dental treatment modality in different ways. So modern medicine can adopt this alternate cheap and effective extract to treat and cure gingival and periodontal disease. Also, banana stem extract can be a possible panacea in management of lichen planus and lichenoid reaction.

So, the present review reflected the possibility of utilization of *Musa paradisiaca* stem extract for oral and dental applications. Further invitro studies and human trials should carried out to synthesis evidence for its applications in dental point of view, so that utilisation of cheap, easily available banana stem extract can be considered as a stepping stone in dental field.

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