

CONTROLLING OF ORAL PATHOGENS USING *Musa sapientum* STEM MEDIATED SILVER NANOPARTICLES

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ABSTRACT:

Introduction: Plants are used for various purposes in our day to day life. Plants are a valuable source of bioactive compounds and it is used for medicinal purposes all over the world. Recently, many drugs are being synthesised from medicinal plants and they are used to treat various diseases including cancers.

Aim: The aim of the present study is to study the antimicrobial activity of *Musa sapientum* stem mediated silver nanoparticles.

Materials and methods: One gram of dry powder of *Musa sapientum* was weighed and taken. 100ml of water was used, the mixtures were taken in a conical flask and boiled for 20 minutes at 50°C. The extracts were placed in pre-weighed flasks before drying. The validation of the procedure was done by principal investigators and experts in nanotechnology. Finally the extract was used for testing the antimicrobial activity against oral pathogens.

Results: The zone of inhibition for *Streptococcus mutans* at 25µL it shows 12mm, at 50µL it shows 15mm, at 100µL it was 18mm and at antibiotic it shows 26mm. Overall *streptococcus mutans* have a greater zone of inhibition at all the concentrations.

Conclusion: Based on the results recorded in the present study, it is concluded *Musa sapientum* has a potential antimicrobial activity on human oral pathogenic microorganisms. Hence the present study findings provide a wonderful scientific base for some of the medicinal claims of *Musa sapientum*.

Key words: Medicinal plants, *Musa sapientum*, silver, oral pathogen.

INTRODUCTION:

Medicinal plants are frequently used in traditional medicine to treat different diseases in different areas of the world. 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 as well as helped in exploration of different medicinal plants to find the scientific basis of their traditional uses(1). *Musa sapientum* is a perennial herb that grows 5 - 9 m in height, with tuberous rhizome, hard, long pseudostem. The inflorescence is big with a reddish brown bract and is eaten as vegetables. The ripe fruits are sweet, juicy and full of seeds and the peel is thicker than other bananas(2). The fruit of *M. paradisiaca* and *M. sapientum* is traditionally used in diarrhoea (unripe), dysentery, intestinal lesions in ulcerative colitis, diabetes (unripe), in sprue, uremia, nephritis, gout, hypertension, cardiac disease. *M. sapientum* is also used in the treatment of excess menstruation with *Canna indica* L. var. *speciosa*. Banana leaves (ashes) are used in eczema as cool dressings for blisters and burns (3). Flowers are used in dysentery and menorrhagia. Stem juice of fruit is used for treating diarrhoea, dysentery, cholera, otalgia, haemoptysis and flower is used in dysentery, diabetes and menorrhagia. The root is used as anthelmintic, blood disorders, and venereal diseases. The plant is also used in inflammation, pain and snakebite. Plantain and banana plants are among the most important staple food crops in the humid forest zone of West and Central Africa(4). This is due to the contribution of the crops to food security,

employment and diversification of income sources in rural and urban areas, hence contribution to the gross national product (GNP) . Banana is the world's second most important fruit crop after oil palm. It is grown in 130 countries worldwide, world production stood at 71 million metric tons of banana, while plantain is grown in 52 countries with world production of 33 million metric tons per year(5). Plantains are of less importance than bananas in terms of world trade in the genus but in West and Central Africa about 70 million people are estimated to derive more than one quarter of their food energy requirement from plantains . The plantain (*Musa paradisiaca*) and banana (*Musa sapientum*) pseudostem wastes are abundant and widely available as a lignocellulosic material(6). Maloney (1978) stated that lignocellulosic materials are the most abundant polymers on earth which are obtainable as the original biomass. Lignocellulosic materials are mainly constituted from three natural polymers namely: cellulose, lignin and hemicelluloses in varying proportions depending upon the specific plant in which they occur (7). The use of lignocellulosic materials as a base for the production of chemicals is very small in relation to the amount generated annually. This, according to Maloney (1978), is because it has been less expensive to derive carbon based chemicals from fossil fuels, especially natural gas and petroleum(8). Previously Our team has extensive knowledge and research experience that has translate into high quality publications (9–13),(14),(15),(16),(17),(18),(19),(20,21),(22–26) ,(27),(28)(29–43) over the past 5 years. The aim of the present study is to evaluate the antimicrobial activity of *Musa sapientum* Stem mediated silver nanoparticles by controlling the oral pathogens.

MATERIALS AND METHODS:

One grams of dry powder of *Musa sapientum* were weighed and taken, it was commercially available in powder form and hence easy to purchase. 100ml of distilled water was added (Figure:1). The mixtures were taken in a conical flask and covered with aluminium foil and kept in an orbital shaker for 24 hours, these procedures were done under the guidance of lab technicians (Figure :2,3). On the next day the mixture was kept on a magnetic stirrer. Then the extract was filtered using Whatman filter paper no.1 on a Buchner funnel (Figure : 4). The filtering process required more time. Then the filtered mixture was boiled at 50°C for 20 minutes. The extracts were placed in pre-weighted flasks before drying. The validation of the procedure was done by principal investigators and experts in nanotechnology. Finally the extract was used for testing the antimicrobial activity against oral pathogens .



Fig 1: Dry powder of *Musa sapientum* was weighed and taken and 100ml of distilled water is added.



Fig 2: The mixtures were taken in a conical flask and covered with aluminium foil

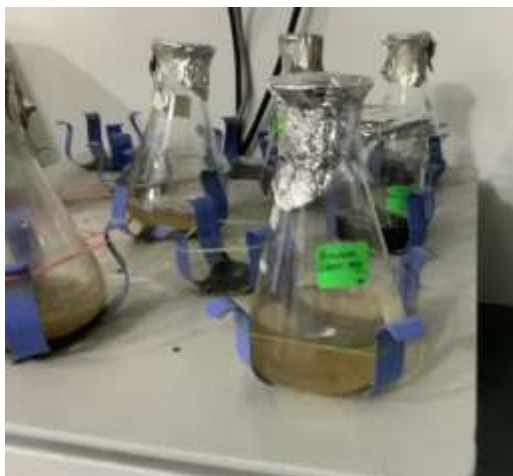


Fig 3: The mixtures were taken in a conical flask and covered with aluminium foil and kept in an orbital shaker



Fig 4: The extract was filtered using Whatman filter paper no.1 on a buchner funnel.

Antibacterial Activity:

Antibacterial activity of *Musa sapientum* Stem mediated silver nanoparticles against the strain *Staphylococcus aureus*, *Streptococcus mutans*, *Enterococcus faecalis* and *Candida albicans*. MHA agar was utilized for this activity to determine the zone of inhibition. Muller hinton agar was prepared and sterilized for 45 minutes at 120lbs. Media poured into the sterilized plates and let them stabilize for solidification. The wells were cut using the well cutter and the test organisms were swabbed. The nanoparticles with different concentrations, Amoxicillin (Control) were loaded and the plates were incubated for 24 hours at 37 ° C. After the incubation time the zone of inhibition was measured. The assessment of the anti microbial activity was based on the measurement of the diameter of the inhibition zone formed around the well and the mean values were recorded. In this study, using this plant extract, antioxidants and anti-inflammatory activity can also be performed. The correlation analysis was done to analyse the antibacterial activity of *Musa sapientum* plant extract.

Test organisms: Two microorganisms are used in this research as test organisms consisting of *streptococcus mutans*, *Enterococcus faecalis*, *Enterofaecalis* and *Candida albicans*.

RESULTS AND DISCUSSION:

Antibacterial activity of *Musa sapientum* stem mediated silver nanoparticles in gram positive bacteria with different concentration(μ L) and zone of inhibition(mm) are mentioned in Table:1. Antimicrobial activity of *Musa sapientum* stem mediated silver nanoparticles showing zone of inhibition were analysed by well diffusion method. (Figure:5). Antifungal activity of *Musa sapientum* stem mediated silver nanoparticles against oral pathogen showing positive correlation with increase in concentration (Graph:2).

Table 1: Antibacterial activity of *Musa sapientum* stem mediated silver nanoparticles in gram positive bacteria with different concentration(μ L) and zone of inhibition(mm)

NAME OF THE PATHOGEN	ZONE OF INHIBITION [Concentration in mm]
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	25µL	50µL	100µL	Antibiotic(150 µL) [Amoxicillin]
Streptococcus mutans	12	15	18	26
Staphylococcus aureus	15	17	18	25
Enterofaecalis	9	9	12	30
Candida albicans	12	13	15	12

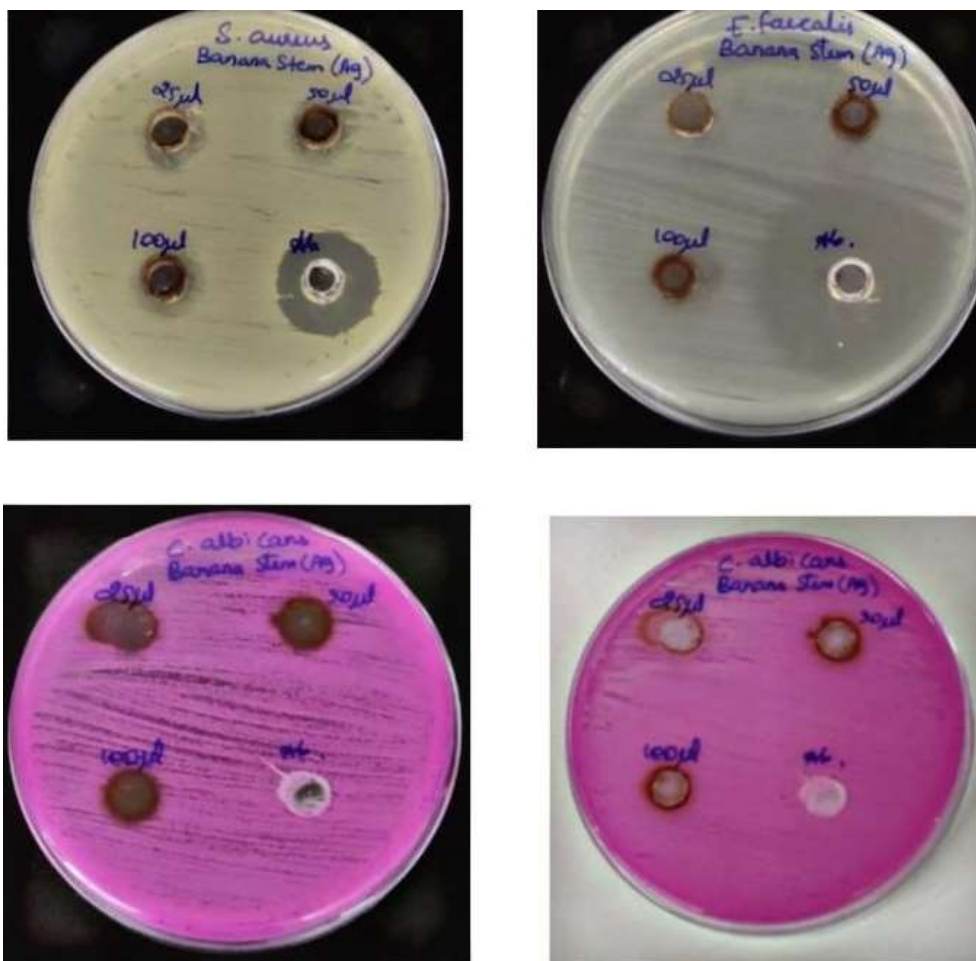
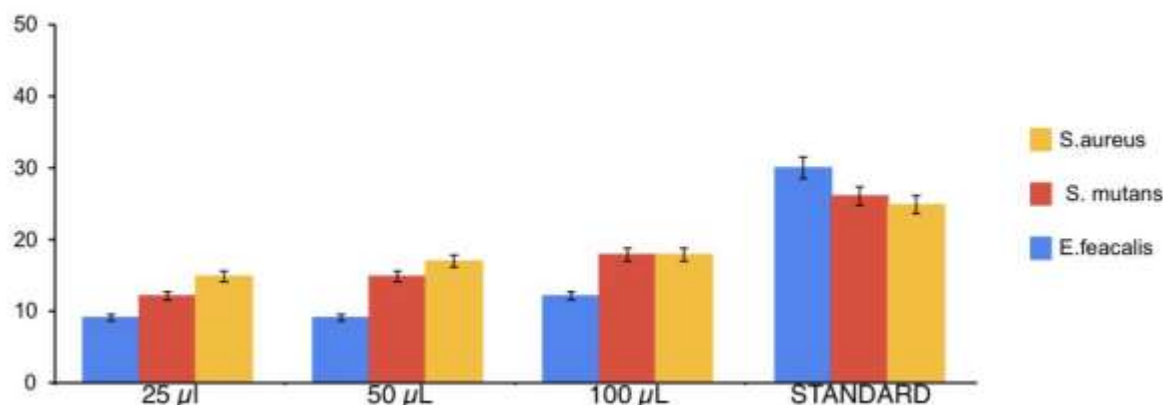


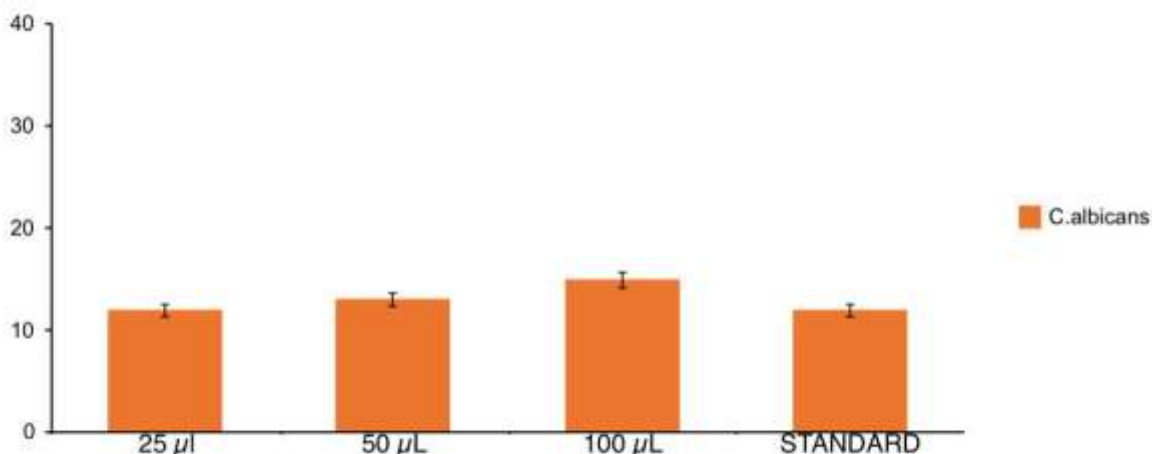
Fig 5: Antimicrobial activity of Musa sapientum stem mediated silver nanoparticles against oral pathogens(*Streptococcus mutans*,*Staphylococcus aureus*,*Enterofaecalis*,*Candida albicans*) showing zone of inhibition analysed by well diffusion method.

ANTIMICROBIAL ACTIVITY OF *M.sapietum* MEDIATED SILVER NANOPARTICLE



Graph 1: Antimicrobial activity of *Musasapietum* stem mediated silver nanoparticles against oral pathogens showing positive correlation with increase in concentration(mm). Standard (Amoxicillin- 150 µL) had a greater zone of inhibition.

ANTI FUNGAL ACTIVITY OF *M.sapietum* MEDIATED SILVER NANOPARTICLE



Graph 2: Antifungal activity of *Musa sapientum* stem mediated silver nanoparticles against oral pathogens showing positive correlation with increase in concentration(mm).

It has been suggested that phytochemical extracts from plants hold promise to be used in allopathic medicine as they are potential sources of antiviral, antitumoral and antimicrobial agents(3).The therapeutic and pharmaceutical value of medicinal plants lies in the chemical constituents present in them Plants are known to have various beneficial therapeutic effects documented in the Traditional Indian System of Medicine. Number of work has been done on medicinal plants in India. The use of traditional natural products has increased.. The effects of plant extracts on bacteria have been studied by a very large number of researchers in different parts of the world. Medicinal plants are of great use in our day to day life.And it also increases the ability of thinking (44).The effects of plant extracts on bacteria have been studied by a very large number of researchers in different parts of the world Medicinal plants are of great use in our day to day life(45).

Musa sapientum (*M.sapientum*) commonly known as ‘banana’ is widely used in Bangladeshi folk medicine for the treatment of various ailments including diarrhea.In the present study, the zone of inhibition for *Streptococcus mutans* at 25µL it was 12mm, at 50µL it was 15mm, at 100µL it was 18mm and at antibioticµL in it was 26mm. The zone of inhibition for *Staphylococcus aureus* at 25µL it was 15mm, at 50µL it was 17mm, at 100µL it was 18mm and at antibiotic µL it was 25mm.The zone of inhibition for *Enterofaecalis*at 25µL it was 9mm, at 50µL it was 9mm, at 100µL it was 12 mm and at antibiotic µL it was 30mm. The zone of inhibition for *Candidiasis albicans* at 25µL was 12mm, at 50µL it was 13mm, at 100µL it was 15mm and at Antibiotic µL it was 12mm(Table 1). The correlation analysis graph showed a positive correlation between the concentration and zone of inhibition. Among the four oral pathogens, *Streptococcus*

mutans showed the maximum zone of inhibition(Graph 1 &2).Although very limited work has been done, it needs further study for verification of its activity against disease-causing microorganisms.

In the previous study, the antibacterial activity was tested against both Gram-positive and Gram-negative organisms. Stem bark extract exhibited good antibacterial activity against the tested organisms. The stem bark extract showed maximum activity against *Enterobacter aerogenes*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Staphylococcus aureus* and the leaf extract showed maximum activity against *Escherichia coli*, *Alcaligenes faecalis* and *Pseudomonas aeruginosa*. *M.sapientum* has wonderful antioxidant, antimicrobial, and anti-inflammatory activities (46)(47)(48). Based on the results of this study we can say there is great hope for the development of this plant *M.sapientum* to obtain antimicrobial compounds that are more promising and more effective,(49).The use of medicinal plants in dental practice should be encouraged. A single medicinal plant shows a variety of effects like anti-inflammatory, antibacterial, antifungal activity and many more. Hence the incorporation of medicinal plants in dental practice will prove to be a valuable adjunct in dental treatment. Use of medicinal plants as medicine is increasing worldwide. Medicinal plants are safe with no side effects and they possess effective action against bacteria and other microorganisms(50). Awareness of traditional knowledge of medicinal plants can play a major role in the discovery of natural plant resources. In order to maintain this knowledge, awareness is needed to maintain historical records on medicinal plants and use these resources in favour of human beings, before they are destroyed forever (51).In the present study, only four oral pathogens were tested for antibacterial activity.In future studies, more number of oral pathogens can be tested and new antibacterial drugs can be developed from the *Musa Sapientum*stem mediated silver nanoparticles. Our team has extensive knowledge and research experience that has translate into high quality publications 52)(53)(54)(55)(55,56)(57)(58)(59)(60)(61)(62)(63)(64)(65)(66)(67)(68).

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CONFLICT OF INTEREST:The authors declare that there was no conflict of interest

CONCLUSION:From the present study it is concluded that the extracts of *Musa Sapientum*stem mediated silver nano particle were found to be an antibacterial agent against oral pathogens.Further studies should be undertaken to elucidate the exact mechanism of action by which extracts exert their antimicrobial effect to identify the biological active ingredients which can be used in drug development program for safe health care services. The antimicrobial potential of *Musa Sapientum*in terms of its efficacy and versatility is such that further detailed research appears crucial.

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