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Research Article

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An Ecofriendly approach for synthesis of Silver Nanoparticles using *Ficus benghalensis* aerial root extract and Application of Nanotechnology in Dental science

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Abstract

Nanotechnology deals with the particles which are less than 100nm and have important roles in medicines, industries, drug gene delivery etc. Plant mediated biosynthesis of metallic nanoparticles have very high commercial value due to their wide application in various field including Nano medicines. Oral problems are major health problems. Dental caries is a major problem mainly consist of bacterial plaque and oral microbes. The nanotechnology plays an important role in dentistry such as prevention of oral diseases. In this paper the silver nanoparticles was synthesized from *Ficus benghalensis* aerial root extract. Phytochemicals present in this root extract were analyzed. The synthesized nanoparticles were characterized by means of UV –Visible spectrophotometer, Atomic Force Microscopy and Fourier Transform Infra-Red Spectroscopy. The synthesized nanoparticles showed maximum absorbance at 310nm and the particles size was about 580nm and it was in spherical shape which was showed by AFM analysis. The phytochemical screening showed the presence of alkaloids, steroids, saponins, phenols, proteins and tannins. The antimicrobial activity was investigated against oral pathogens and synthesized nanoparticles showed antimicrobial activity against *Micrococcus* and *Enterobacteria.* Based on its antimicrobial activity against oral pathogens the nanoparticles were used for the preparation of dental restoration material using type II and type IX GIC. The nanoparticles also used for the preparation of nanomouthwash and both dental restoration material and nano mouth wash tested against dental pathogens which showed good inhibition. Thus nanoparticles were used in dental science which is an ecofriendly, simple, less costly method.

Keywords: *Ficus benghalensis* aerial roots, phytochemical composition, silver nanoparticles, antimicrobial activity.

Introduction

Nanotechnologydeals with the particles which are less than 100nm and have important roles in medicines, industries, drug gene delivery etc. The size of the nanoparticles size is similar to most of the biological molecules and structures therefore the nanoparticles may be used for both in vivo and in vitro biomedical research and applications. (Saware *et al.,* 2014).

The nanoparticles were made from different materials like metal oxides, most commonly used metals are gold and silver (Kaur *et al*., 2013). Since the silver is known for its antimicrobial activity, the silver nanoparticles can be used against infection. (Akhtar *et al.*, 2015). The silver nanoparticles were synthesized from many plant varieties. In present study the silver nanoparticles were synthesized from aerial roots of *Ficus benghalensis.* Different parts of the *F. benghalensis* shows medicinal properties. Leaves are used for ulcers, aerial roots are used in gonnohea, seeds and fruits are used for dysentery, diarrhea and diabetes. (Mandal *et. al.,* 2010).

The aerial roots of *Ficus benghalensis* are the type of adventitious roots which are developed from plant stem from the plant stem or leaf tissues. The aerial roots of *Ficus benghalensis* have been reported to have immunomodulatory, antibacterial and hair growth promoting activity (Tabassum Khan *et al.,* 2015). There are many secondary metabolites present in *Ficus benghalensis* such as alkaloids, phenols, saponins, proteins, tannins, flavonoids These phytochemical can be used for many treatments such as skin diseases, ulcers, diarrhea ,dysentery, piles, gonorrhea ,etc.(Shoba *et al.,* 2015).

Dental caries is a problem mainly consist of bacterial plaque and oral microbes. The dental caries were identified as tooth decay. Caused by the bacteria such as *Streptococcus mutants, Lactococcus, Staphylococcus, Enterobacteria* species. Plants are able to produce varieties of compounds against pathogens. (Abubacker *et al.,* 2015). The roots of *Ficus* species can be used to treat the toothache (Smith *et al.,* 2017).

The herbal products used in dentistry is effective to treat the dental infection. The herbal mouthwashes have lesser side effects than the conventional mouth washes. Plants products can be used as mouthwashes because of less cost and effective in maintain oral hygiene (Salam *et al*., 2015). Nano scale compound is used for the preparation materials which are used in dentistry. This method is simple and less cost (Vahabi *et al.,* 2014).

In the present study the *Ficus benghalensis* root extracts were used for the synthesis of silver nanoparticles and its antimicrobial activity against oral pathogens which leads its wide application in dental science.

Materials and Methods

Collection of samples and preparation of plant extracts

The *Ficus benghalensis* aerial roots were collected from Shobhavana, Mijar, Dakshina Kannada, Karnataka in the month of January. The aerial roots were washed and chopped into fine pieces and they were kept for shade drying for one week. Later they were subjected to oven drying for one week. Then the dried roots were finely powdered and stored. Two grams of powder was taken in 100ml of distilled water. The solution was kept in water bath around 45 minutes at 60º C, the solution was cooled at room temperature later this solution was filtered through Whatman filter paper.

The remaining grinded powder was taken for preparation of methonolic and aqueous extracts for phytochemical analysis. About 30grms of powder was taken for the preparation of aqueous extract. About 25gms of powder was taken for the preparation of methonolic extract using soxhlet apparatus.

Phytochemical screening of material

1. Detection of alkaloids

The extracts were dissolved separately in dilute Hydrochloric acid and filtered (Preston *et. al.,* 2015). The filtrates were treated with Wagner's reagent. The brown colored precipitation indicates the presence of alkaloids. (Gopukumar *et. al.,* 2016)

2. Detection of Carbohydrates

The extracts were dissolved individually in 5ml of distilled water and they were filtered. The filtrates were used for the carbohydrates test. The filtrates were hydrolyzed with the dil. HCl, and neutralized with alkali then heated with Fehling's A and Fehling's B solutions. The red colored precipitate indicates the presence of carbohydrates. (Ogunlowo *et al*., 2013)

3. Detection of glycosides

Samples were hydrolyzed with dil. HCl, and then subjected to glycosides test. (Bertrager's test) (Ogunlowo *et al*., 2013)

4. Detection of steroids and terpenoids

In 1ml of plant extracts 1ml of chloroform was added and 2-3 ml of acetic anhydride was mixed then 1-2 drops of concentrated H_2SO_4 was added. Then the dark green coloration of the solution indicated that presence of steroids and pink or red coloration indicates the presence of terpenoids. (Ogunlowo *et al.,* 2013)

5. Detection of saponins

0.5 grams of plant extracts was shaken with 2ml of water. The foam was produced and persists for 10minutetes. It indicated the presence of saponins. (Ogunlowo *et al.,*2013)

6. Detection of tannins

Take 2-3 ml of extracts and add 5% of $FeCl_3$ solution. The deep color indicated the presence of terpenoids. (Gopukumar *et al.,* 2016)

7. Detection of phenols

Ferric chloride test: Extracts were treated with 3-4 drops of ferric chloride solution. The bluish black color indicated the presence of phenols. (Ogunlowo *et al*., 2013)

8. Detection of proteins

Xanthoproteic Test: The extracts were treated with few drops of concentrated nitric acid. Then the formation of yellow color indicated the presence of proteins (Ogunlowo *et al.,* 2013)

9. Detection of flavonoids

In plant extracts 10% NaOH was added dilute HCl was added to that solution. The change of color from yellow to colorless. It indicated the presence of flavonoids. (Ogunlowo *et al.,* 2013)

Synthesis of silver nanoparticles (SNPs)

Ninety milliliters of 1mM $AgNO_3$(Fisher Scientific)was added to 10ml of plant extracts. The solution was mixed with help of magnetic stirrer. The change in the color from yellow to dark brown indicated the formation of silver nanoparticles.

Characterization of silver nanoparticles

The synthesized particles were characterized using UV-Visible Spectroscopy, FTIR analysis and AFM. The UV-Visible Spectroscopy analysis is used to study the absorption peak of synthesized particles. The FTIR analysis is used to study the functional groups present in the synthesized nanoparticles. The AFM analysis is used to study the size of the particles.

UV-Visible spectroscopy

The color change in the reaction mixture was observed through visual observation. The reduction in the silver nitrate indicates the formation of silver nanoparticles. It was visually observed. The absorption peaks of synthesized silver nanoparticles were recorded by UV-Spectrophotometer at 200-400nm.

Fourier Transform Infrared Spectroscopy (FTIR)

The Fourier Transform Infrared Spectroscopy is used to study the infrared absorption of particles. IR spectra were recorded using KBr pellets. On a Perkin-Elmer GX FTIR spectrophotometer.

Atomic Force Microscopy

The nanoparticles were prepared by the solution and the solution was casted onto silicon wafers (III) to make into thin films. These films were analyzed in non-contact mode using a Pacific Nanotechnology Nano- R2 instrument.

Antimicrobial Activity

Preparation of microbial cultures and isolation

The samples were collected from infected area of teeth with help of sterile cotton swabs into a sterile test tubes from Alva's Health Centre, Moodbidri. These samples were swabbed on Petri plates containing Nutrient agar media.

Identification of microorganisms: from the culture plates 4 colonies were isolated.

The isolates were identified based on their morphology, biochemical test and fermentation test.

The characterization of bacterial isolates were as follows:

a) Simple Gram Staining
b) Indole Test
c) Methyl Red Test
d) Citrate Utilization Test
e) Motility Test
f) Starch Hydrolysis Test
g) Fermentation Test – Glucose, Sucrose, Maltose, Lactose, Fructose.
h) Urease activity
i) Gelatin hydrolysis

Bacterial cultures

The overnight bacterial cultures was prepared by sub-culturing the loopful of culture into the Nutrient broth.

Antimicrobial assay

The antimicrobial activity was evaluated by well diffusion method. The organisms were swabbed on the Muller Hilton's Agar plates. The wells were made into the inoculated plates accordingly to the concentration of extracts with the help of sterile cork borer. The different concentrations 40µl, 80µl and 120µl of extracts were added to the wells. PenicillinG disk were placed as a standard. The plates were incubated at 24 hours at 37ºC and zones were measured after the incubation.

Preparation of novel dental restoration material by the incorporation of SNPs

The materials used for this study was Glass Ionomer Cement type II and type IX. The main composition of these cement is the powder and liquid (37% phosphoric acid). The cement contains SiO_2, Al_2O_3, AlF_3, CaF_2, $NaAlF_6$, $AlPO_4$. When cement and liquid was mixed it will form matrix the main difference between type II and type IX is the fillers present in type IX whereas the fillers are absent in type II. The one scoop of cement was mixed with one drop of liquid and 50µl of sample was added to type II and 10µl was added to type IX. The material was allowed to set for 5 minutes.

Solubility test of GIC sample containing SNPs

The tea, coffee and Pepsi media was used for this study. The modified GIC was added to the different drinks and kept for 3 days at 37ºC.

Solubility =M1-M2

Where M1 is the weight before immersion of GIC containing sample and M2 is the weight of after the immersion.

Preparation of nanobased mouthwash

The mouthwashes are used to prevent the dental caries and it helps to maintain the oral hygiene. Since the chemically synthesized mouthwashes having side effects and which makes the drug resistance to microorganisms. So Nano based mouthwashes can be used since it is effective against the oral pathogens (Salam *et al*., since 2015). In the present study the mouthwash is prepared using nanoparticles synthesized from aerial roots of *Ficus benghalensis*. The standard chlorhexidine gluconate mouthwash composition wash taken for the preparation of mouthwash. Instead of chlorhexidine gluconate the hydrogen peroxide is used. Because of its bitter taste, unpleasant and repeated use can produces stains and taste disturbance. The hydrogen peroxide mainly releases hydrogen peroxide by oxidation and reduction. The free radicals produced from the hydrogen peroxide can break the alkene double bond responsible for discoloration and stain removal (Jingta *et al.,* 2013). So in the preparation of mouthwash we have taken 0.2ml of hydrogen peroxide, 0.05g of Sodium fluoride, 0.09ml of nanoparticles containing plant extract and they were diluted to 50ml using distilled water.

Table 1: Composition of mouthwashes

Composition	Chlorhexidine gluconate mouthwash	Nano based mouthwash
Chlorhexidine gluconate	0.20%	-
Sodium fluoride	0.05%	0.05%
Hydrogen peroxide	-	0.20%
$ZnCl_2$	0.09%	-
Plant extract	-	0.09%
Distilled water	50ml	50ml

Antimicrobial activity of GIC contaning nanopaticles

The 24 hours culture was swabbed on the Muller Hinton agar plates. The antimicrobial activity was performed by well diffusion method. The GIC containing nanoparticles were placed on plates and standard Penicillin G was taken. The $AgNO_3$ (Fisher Scientific) was taken as a control. The plates were incubated at 37ºC for 24 hours.

Antimicrobial activity of nanobased mouthwash

The Muller Hinton agar plates were prepared and they were swabbed with 24 hours cultures. The wells are made by using cork bore. The 40µl, 80µl and 120µl concentration was prepared by mouthwash and they were added to the wells. Standard Penicillin G was taken. The $AgNO_3$ (Fisher Scientific) was taken as a control. The plates were incubated at 37ºC for 24 hours.

Results

Phytochemical screening ot the extracts

The phytochemical analysis of methonolic and aqueous extract were summarized in below table 2. The methonolic extracts contains alkaloids, terpenoids, saponins, phenols, proteins, tannins and flavonoids. The alcoholic extracts contain sterpenoids, saponins, phenols, proteins and tannins.

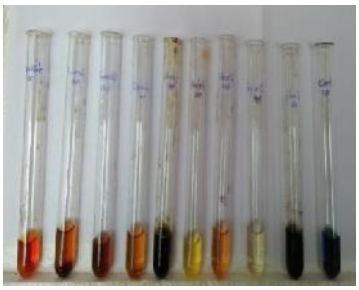

Figure 1: Phytochemical Screening of the extract

Table 2: Phytochemical analysis of aerial roots of *Ficus benghalensis*

Test	Aqueous extracts	Methanolic extracts
Alkaloids	-	+
Carbohydrates	-	-
Glycosides	-	-
Steroids	-	-
Terpenoids	+	+
Saponins	+	+
Phenols	+	+
Proteins	+	+
Tannins	+	+
Flavonoids	-	+

+: Present-: Absent

Synthesis of silver nanoparticles from plant extract

The silver nanoparticles were synthesized by the reduction of silver ions. This was shown by the change in the color of solution from light yellow to dark brown. The color change in the reaction mixer was observed after 2 days is presented in figure: 2.

Figure 2: Color change indicates the formation of nanoparticles

Characterization of synthesized nanopaparticles

UV-Visible specrtoscopy

The change in the color was visually observed which indicates the presence of silver nanopaicles. The change in the color is mainly because of surface Plasmon resonance. The UV-Visible Spectroscopy is an important technique to study the metal nanoparticles.

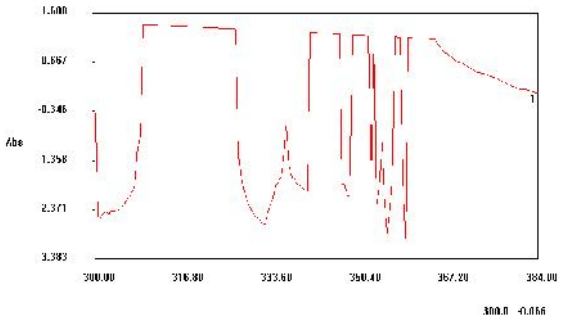

Figure 3: UV absorption spectroscopy

The above figure indicates that the abortion peak of synthesized nanoparticle prepared from *Ficus benghalensis* aerial root extract was at the range of 310nm

Fourier Transform Infra-Red Spectroscopy

The IR spectrum for sample of SNPs showed bands at 3393.57cm^{-1}, 2923.78cm^{-1}, 2854.95cm^{-1}, 1608.80cm^{-1}, 1384.35cm^{-1}, 1100.57cm^{-1}, 1024.03cm^{-1}.

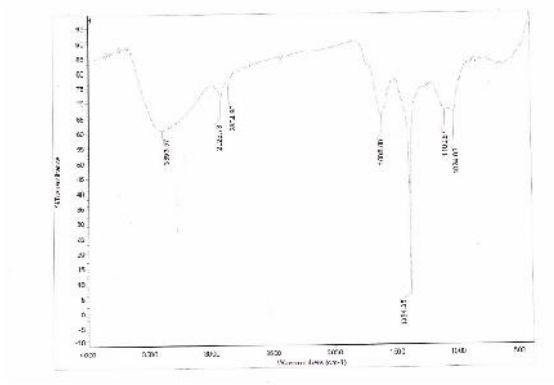

Figure 4: FTIR Spectra of powdered SNPs

The band at 3393.57cm^{-1} represents stretch of C-H bond. The band at 2923.78cm^{-1} corresponding to C-H bond. The band at 2854.95cm^{-1} showed H-C=O bond. The band at 1608.80cm^{-1} represents C-C bond, the band at 1384.35cm^{-1} C-O bond. The band at 1100.57cm^{-1} represents the C-H bond. The band at 1024.03cm^{-1} showed the presence of C-O bond.

Atomic Force Spectroscopy

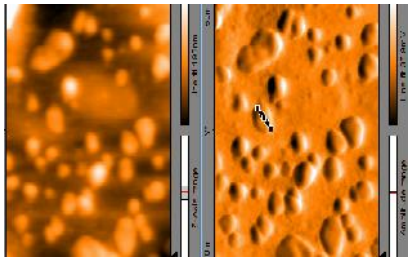

Figure 5: AFM image of silver nanoparticle

The AFM was used to observe the surface morphology and roughness. Figure 5 showed the particles were in spherical shape with size about 580nm. The size of the particle much larger than the SEM, because of magnification and preparation of sample for AFM.

Antimicrobial Assay

Identification of bacterial cultures

From the culture plates 4 colonies were isolated. And they are identified based on its morphology and biochemical test of isolates were tested according to the Bergey's manual of Bacteriology. The morphology and biochemical properties of 4 isolates are as follows

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Figure 6: Citrate utilization test

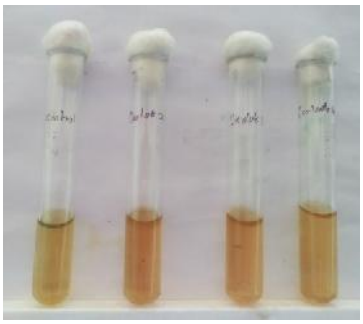


Figure 7: Indole test

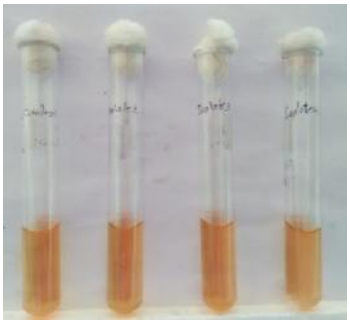


Figure 8: methyl redtest

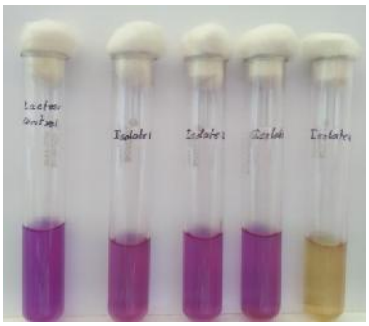


Figure 9: Sugar fermentation test

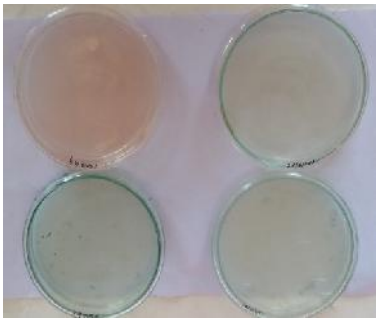


Figure 10: Urease activity

Table 3: Results of Biochemical test

Test		Isolate 1	Isolate 2	Isolate 3	Isolate 4	Results	
						Positive	Negative
Morphology		Cocci	Short rods	Cocci	Cocci	-	-
Simple Gram staining		-	-	+	+	Purple	Pink
Indole test		+	+	+	+	Ring	No ring
Methyl Red test		-	-	-	-	Red	No red
Citrate utilization test		-	-	-	+	Blue	Green
Motility test		-	-	-	-	Movement	No movement
Starch hydrolysis test		+	+	+	+	Clear zone	No zone
Catalase		+	+	+	+	Effervescence	No effervescence
Fermentation test	Maltose	+	-	+	+	Yellow	Pink
	Glucose	-	-	+	+	Yellow	Pink
	Sucrose	-	-	+	+	Yellow	Pink
	Fructose	-	-	+	+	Yellow	Pink
	Lactose	-	-	-	+	Yellow	Pink
Urease activity		-	-	-	+	Pink	No pink
Gelatin hydrolysis		-	-	-	-	Gelatin in liquid state	Gelatin in solid state

+ Positive and - Negative

Based on these study the organisms may be *Neisseria,* (isolate 1),*Enterobacteria* species(isolate 2) *Micrococcus*(isolate 3) and *Staphylococcus(*isolate 4)

Antimicrobial activity of nanoparticles against oral pathogens

The antimicrobial activity was tested on all the 4 isolates. But the inhibition zone was observed for only isolate 2 and 3. The maximum inhibition zone was observed for isolate 3 (32mm) and isolate 2 showed inhibition zone (12mm). From the below graph 1 it is clear that the there is inhibition zone for isolate 1 and isolate 4.

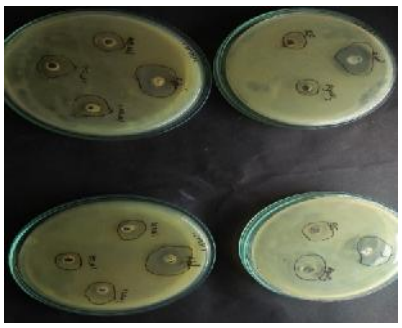
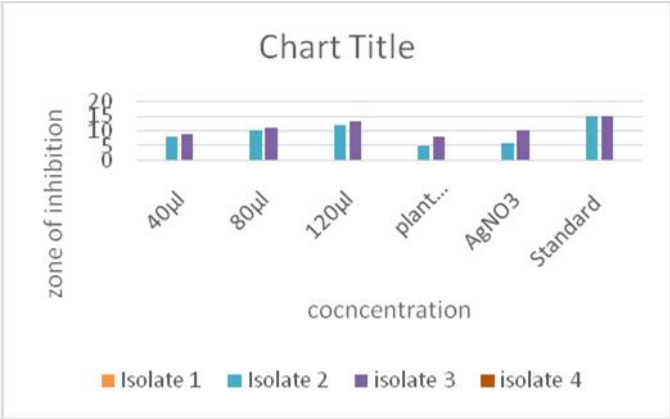


Figure 11: Antimicrobial activity of synthesized nanoparticles

Table 4: antimicrobial activity of synthesized nanoparticles

Isolates	Zone of inhibition(in mm)					
	40µl	80µl	120µl	Plant extract	$AgNO_3$	Standard
Isolate 1	0	0	0	0	0	0
Isolate 2	8	10	12	5	6	15
Isolate 3	9	11	13	8	10	15
Isolate 4	0	0	0	0	0	0



Graph 1: Antimicrobial activity of silver nanoparticles against oral pathogens

Preparation of dental restoration material by the incorporation of silver nanoparticles (SNPs)

The GIC was prepared by using type II and type IX cement. The nanoparticles containing was added during these cement preparation the setting time was less and color of the cement changed from white to skin color. But one disadvantage is that the strength of the cement may be affected and viscosity also reduced.

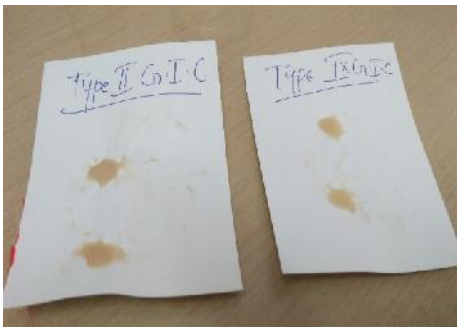


Figure 12: Preparation of GIC containing Silver Nanoparticles (SNPs)

Solubility test of GIC containing SNPs

One of the main feature of restoration material in dental treatment is mainly depend on its stability. Here 2 types of cements are used for the solubility test. The material was placed in different media for 3 day incubation.

Figure 13: Solubility test GIC containing SNPs

Table 5: The percentage of solubility was tabulated in the below table.

Test samples	Type II GIC (in Gram)	Type IX GIC (in Gram)	% of solubility
Tea(Red label)	1.7	1.6	10
Coffee(Nescafe)	1.9	1.8	10
Pepsi (Coco cola)	1.6	1.4	20

The materials showed higher solubility in tea than compare to Pepsi. The type IX is less soluble than compare to type II

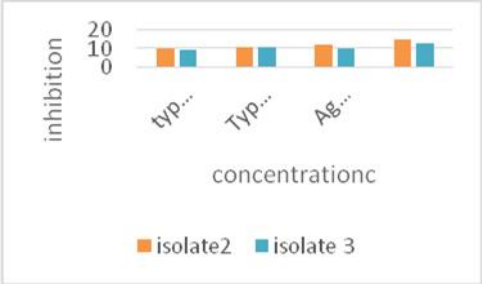
Antimcrobial activity of GIC containing silver nanoparticles (SNPs)

The antimicrobial activity was tested on Isolate 2 and isolate 3 by well diffusion method. Here they were placed on MH agar plates which are swabbed with oral strains. The type IX was more effective than the type II GIC The zone of inhibition observed from the below graph 2. The type IX showed maximum zone (11mm and 11mm) of inhibition for isolate 2 and 3.

Table 6: Antimicrobial activity of GIC

Isolates	Zone of inhibition (in mm)			
	Type II GIC	Type IX GIC	$AgNO_3$	Standard
Isolate 2	10	11	12	15
Isolate 3	9	11	10	13

Figure 14: Antimicrobial active



Graph 2: The antimicrobial activity of GIC Containing SNPs

Preparation of nanomouthwash and its antimicrobial activity

The Nano mouth wash was prepared and they are subjected to antimicrobial activity. The different of 40µl, 80µl and 120µl concentrations of mouthwash is prepared they are tested against oral pathogens. The zone of inhibition was observed and they are reported as follows. .From the below graph 3 it is observed that the maximum zone of inhibition observed for isolate 3 (16mm) than isolate 2 (15mm) at a higher concentration of 120µl.

Figure 15: Nano based mouthwash

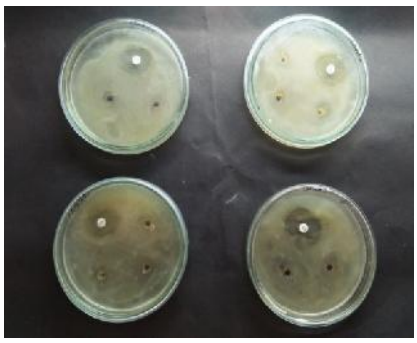
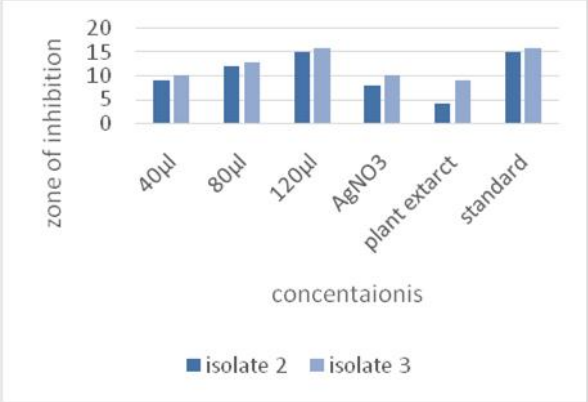


Figure 16: Antimicrobial activity of Nano Based mouthwash.

Table 7: Antimicrobial activity of Nano based mouthwash

Isolates	Zone of inhibition (in mm)					
	40µl	80µl	120µl	$AgNO_3$	Plant extract	Standard
Isolate 2	9	12	15	8	4	15
Isolate 3	10	13	16	10	9	16



Graph 3: Antimicrobial activity Nano based mouthwash

Discussion

The change in the color of the extract indicates the formation of nanoparticles. The color change was mainly because of reduction of silver. Singh *et al., (*2015), synthesized nanoparticles from aerial root tip of *Ficus benaghalensis* extract. There was color change from yellow to brown. Saware et al., synthesized silver nanoparticles from *Ficus benaghalensis* leaf extract the color change observed from colorless to brown. Kavitha M and Thirumurugan V (2017) synthesized nanoparticle from *Ficus benghalensis* bark the color change was from yellowish to brown. Abubacker *et al.,* (2015) prepared silver nanoparticle from *Ficus benghalensis* chewing sticks, the color was observed s dark brown. In the present study the silver nanoparticles were synthesized from the aerial roots of *Ficus benghalensis* and there was color change from light yellow to dark brown.

Venkataraman *et al.,* (2015), studied on different phytochemical in Moraceae family. The mainly identified phytochemicals were alkaloids, phenolic compounds, tannins, flavonoids, glycosides, carbohydrates. Govinda *et al.,* (2015), reported on the secondary metabolites in *Ficus benghalensis* seed. They analyzed carbohydrates, tannins, saponins, flavonoids, alkaloids, quinones, glycosides. Salam *et al.*,(2013) studied on the phytochemical composition of *Ficus benghalensis*. They identified glycosides, flavonoids, phenolic compounds, carbohydrates in the aqueous extracts of aerial root extract. In the present study the phytochemicals present in the root extracts of *Ficus benaghalensis* contains alkaloids, terpenoids, saponins, phenols, proteins, tannins in methonolic extract and alkaloids absent in the aqueous extract.

Saware *et al.,*(2014), prepared silver nanoparticles using *Ficus benghalensis* leaf extract. The UV absorption peak was observed at 280nm. Mariselvam *et al.,* 2015, prepared synthesized the aerial root tip mediated silver nanoparticles. The UV absorption peak was observed at 428nm. Rakhi M. *et al.,*(2013), worked on *Ficus benghalensis* root tip mediated gold nanoparticles. The UV absorption peaks observed at 536-543nm.in the present study the UV absorption peak for sliver nanoparticles synthesized from *Ficus benghalensis* aerial root extract was 310nm.

Saware *et al.,*(2014), synthesized nanoparticles from *Ficus benghalensis* leaf extract. The FTIR results was in the range of 1064-1054cm^{-1}. Mariselvam *et al.,* 2015, prepared aerial root tip mediated silver nanoparticles. The FTIR results was in the range of 879.17cm^{-1} – 3340cm^{-1}. Shobha V *et al*., synthesized nanoparticle from root extract of Ipomea pes caprae. The FTIR results was the range of 3535-1043cm^{-1}. In the present study the FTIR result found to be 3393.57cm^{-1}-1024.03cm^{-1}.

The AFM for *Ficus benghalensis* leaf extract was studied by Saware *et al.,* (2014). The AFM result was about 35nm. In the present work the AFM for 580nm.

The antimicrobial activity of synthesized nanoparticles against oral pathogens carried out. Salam *et al.,* (2015), worked on the antimicrobial activity of plants for oral health and hygiene. They tested activity of *Azadirachta indica*, piper betle against *Streptococcus mutants, Enterobacteria*. Smith *et al.,* (2017), studied on plants used against oral pathogens. The roots of *Ficus benghalensis* can be used for the treatment oral problems. Krumina*et al.,* (2015), studied on the influence of plant extract on the oral pathogens. They used citrus, cinnamon, Acorus, lavender against oral pathogens. The cinnamon showed highest antimicrobial activity. Lekshmi *et al.,* worked on the antimicrobial activity of *A. indica* against dental pathogens. The ether and petroleum extract showed good antimicrobial activity. In the present study the antimicrobial activity of silver nanoparticles from *F. bengalensis* root extract tested on oral pathogens. There was inhibition against *Micrococcus and Enterobacteria* species.

Agarwal *et al.,* (2014), reported on preparation of dental restoration from *Azadirachta indica* leaves. Here they used type II GIC for the preparation of dental restoration material. The synthesized material was tested against *S mutants*. Sandeep *et al.,* (2017), prepared GIC from *Mangifera indica* and its antimicrobial activity tested on *E. coli*. In the present report the type II and type IX used for the preparation of GIC. The synthesized material was tested against oral strain

The solubility test of dental restoration material was done Agarwal *et al.,* (2014), used coffee, tea, coco cola as a media for solubility test. They got maximum solubility for Coco cola and in the present study the solubility test performed using tea, coffee and Pepsi. The more solubility found in Pepsi. Since the Pepsi contains phosphoric acid and citric acid has an erosive effect on enamel and dentine.

Asghar B., (2017), prepared alcoholic free mouthwash using nanoparticles. They used propylene glycol, sodium fluoride for the preparation of mouthwash and they tested prepared mouthwash against *S. mutants, C. albicans*. In the present work the mouthwash prepared from *Ficus benghalensis* aerial root extract. The prepared mouthwash was tested against *Micrococcus* and *Enterobacteria* species.

Conclusion

The nanotechnology plays an important role in many industries. The nanotechnology also has an importance in dentistry. The nanoparticles were synthesized from biological means. The biological method is safe, easy than compare to physical and chemical method. The biological method reduces chemicals.

The nanoparticles synthesized from *Ficus benghalensis* this was indicated by change in color there was color change from light yellow to dark brown. And the synthesized nanoparticles were characterized by different means. The synthesized nanoparticles were tested against oral pathogens. These particle showed good inhibition zone for oral pathogens. The phytochemical analysis showed that the phytoconstituents can be used for the drug preparation.

The synthesized nanoparticles were used for the preparation of GIC. Here type II and type IX GIC were incorporated with nanoparticles. These GIC compound was tested against oral microbes. These confirms that the nanoparticle used for the preparation of dental restoration material. The disadvantage with this material is like the consistency of cement may be lossed. Solubility test was made between to 2 types of cement. The type IX was more efficient than compare to type II.

Here in this report the mouth wash was prepared using nanoparticles. The chlorhexidine gluconate has a bitter taste, unpleasant and it makes microorganism resistance to drugs by repeated use. Here hydrogen peroxide is used since it kills microorganisms. The mouthwash prepared using nanoparticle it was tested against oral pathogens. It showed good inhibition zone. So it indicates that the herbal based nanomouth was better, safe, less cost and ecofriendly than compare to chemically prepared mouthwash. But here the hydrogen peroxide is used so should take care when using, it should not be swallowed, should not be taken in high dosage. It may leads to toxicity.

Finally with this report I concluded the nanoparticles prepared from aerial root extracts of *Ficus benghalensis* showed good antimicrobial activity against oral microbes. Thus these nanoparticles can be used to treat many oral disease and has a wide application in dental field.

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