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"TO CHECK ANTIMICROBIAL POTANTIAL OF GREEN SYNTHESIZED NANOPARTICLES ON DENTAL PATHOGENS AND DEVELOP DENTAL FORMULATION"

Exploring Antimicrobial Efficacy of Eco-Friendly Nanoparticles for Dental Pathogens and Formulation Development

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Abstract: In the field of dental healthcare, combating microbial pathogens remains a critical challenge. This study delves into the potential of utilizing environmentally friendly synthesized nanoparticles as a means to address this issue. The primary focus is on assessing the antimicrobial efficacy of nanoparticles created through a green synthesis approach, targeting dental pathogens. Concurrently, the research endeavors to develop an innovative dental formulation that incorporates these nanoparticles.The methodology involves the synthesis of nanoparticles using biocompatible and sustainable materials, emphasizing a green approach that aligns with current environmental concerns. The synthesized nanoparticles are characterized using various analytical techniques to determine their physicochemical properties, such as size, morphology, and composition.Subsequently, the antimicrobial potential of these nanoparticles is evaluated against a panel of dental pathogens, including bacteria known for their involvement in oral health complications. The assessment encompasses both qualitative and quantitative analyses of the nanoparticles' inhibitory effects on microbial growth and biofilm formation.Moreover, the study extends its investigation to the development of a novel dental formulation enriched with the synthesized nanoparticles. The formulation aims to leverage the antimicrobial properties of nanoparticles while ensuring their compatibility with dental applications. Physicochemical characterization of the formulated product is performed, along with an assessment of its antimicrobial activity.The outcomes of this research have the potential to contribute significantly to dental healthcare. The utilization of green synthesized nanoparticles as effective antimicrobial agents could lead to innovative strategies for combating dental pathogens and associated diseases. Furthermore, the development of a nanoparticle-infused dental formulation introduces a promising avenue for enhancing preventive and therapeutic dental treatments.

Index Terms **-** Antimicrobial potential, Green-synthesized nanoparticles, Dental pathogens, Dental formulation, Nanotechnology in dentistry, Nanoparticle-based antimicrobial agents, Dental caries, Periodontal diseases, Oral health, Green synthesis of nanoparticles, Biocompatibility, Dental materials, Antimicrobial resistance, Nanoparticle characterization, In vitro and in vivo studies, Dental hygiene, Oral microbiome, Therapeutic agents for dental applications, Antibacterial nanoparticles

I. INTRODUCTION

In recent years the escalating problem of antibiotic resistance among dental pathogens has posed significant challenges in the field of dentistry. To combat this issue researchers have been exploring alternative approaches such as the utilization of nanoparticles (NPs) with antimicrobial properties. Additionally, the synthesis of these NPs through green methods using natural sources has gained attention due to its eco-friendly and sustainable nature. This introduction will provide an overview of the topic highlighting the antimicrobial potential of green synthesized nanoparticles on dental pathogens and the development of oral formulations.[1]

Green synthesis involves employing plant extracts microorganisms or other natural sources as reducing and stabilizing agents for the production of nanoparticles. This method offers several advantages over conventional synthesis approaches including cost-effectiveness biocompatibility and the ability to produce NPs with diverse antimicrobial properties. Green synthesized nanoparticles have demonstrated remarkable efficacy against various microorganisms in different fields including medicine and biotechnology. However, their application specifically in dentistry focusing on dental pathogens is an area that shows immense promise.[2]

Dental pathogens such as Streptococcus mutans Porphyromonas gingivalis and Candida albicans are responsible for causing oral infections dental caries and periodontal diseases. The rise in antibiotic-resistant strains of these pathogens necessitates the development of novel strategies to combat them effectively. Green synthesized nanoparticles have exhibited significant antimicrobial activity against a wide spectrum of microorganisms including bacteria fungi and viruses. The mechanisms by which these nanoparticles exert their antimicrobial effects include disrupting the cell membranes inhibiting enzyme activity inducing oxidative stress and interfering with the genetic material of the pathogens. [3]

1.1 HISTORY In the past ten years, there has been a growing interest in using nanoparticles for dentistry due to the need for new and innovative ways to fight oral infections and tackle antibiotic resistance. Making nanoparticles using environmentally friendly methods has emerged as a green and sustainable option compared to traditional chemical techniques.[4]

1.2 SIZE OF NANOPARTICLES The size of nanoparticles used in studies exploring the potential of green synthesized nanoparticles to combat dental pathogens and develop oral treatments can vary based on the specific research and experimental design. Typically, nanoparticles range in size from 1 to 100 nanometers.[5]

1.3 PATHOGENS

Streptococcus mutans bacteria are a primary cause of dental cavities and are known for their ability to create acid and form biofilms on teeth.

Porphyromonas gingivalis is a significant pathogen associated with gum diseases like gingivitis and periodontitis. It's known for invading and persisting within gum tissues, causing ongoing inflammation and damage.

Candida albicans fungus is an opportunistic pathogen commonly linked to oral candidiasis, a fungal infection that can occur in the mouth, especially in people with weakened immune systems.[6]

1.4GREEN SYNTHESIS OF BIOLOGICAL NANOPARTICLES Creating nanoparticles using eco-friendly methods involves using natural sources like plant extracts, microorganisms, or other biomaterials as agents to reduce and stabilize. Here's a general overview of the steps in the green synthesis of nanoparticles:

Choosing the Green Source: Select a suitable natural source based on its availability, properties, and potential for nanoparticle creation. This could include plant extracts, microorganisms, or other biomaterials.

Extract Preparation: Process the chosen natural source to get an extract containing components needed for nanoparticle synthesis. This might involve grinding, crushing, or blending the source material and using solvents or water to extract it.

Reducing and Stabilizing: Mix the extract with a solution containing metal salts or other materials required for nanoparticle synthesis. The natural compounds in the extract act as reducing agents, helping to form nanoparticles from metal ions. These compounds can also stabilize the nanoparticles, preventing clumping and promoting stability.

Heating or Reaction: Apply suitable heating or reaction conditions to aid in the reduction and growth of nanoparticles. This could mean heating the reaction mixture to a specific temperature or subjecting it to controlled conditions like adjusting pH or exposing it to light, depending on the synthesis method and desired nanoparticle properties.

Characterization and Purification: Once synthesis is done, nanoparticles are typically characterized using techniques like transmission electron microscopy (TEM), scanning electron microscopy (SEM), X-ray diffraction (XRD), or spectroscopy. This helps determine the size, shape, composition, and stability of the nanoparticles. Purification steps like centrifugation or filtration might be used to remove impurities or unreacted materials.[7]

1.5 DEVELOPING AN ORAL FORMULATION WITH GREEN SYNTHESIZED NANOPARTICLES To enhance the effectiveness of green synthesized nanoparticles against dental pathogens, developing an oral treatment is vital. Anderson et al. (2023) focused on creating a mouthwash containing green synthesized zinc oxide nanoparticles. They studied the physical and chemical properties, stability, and antimicrobial activity of the formulation, aiming to improve its ability to manage oral diseases. The study showed promising outcomes, with the formulation demonstrating prolonged nanoparticle release and enhanced antimicrobial activity against common oral pathogens.[8]

2 METHODOLOGIES

2.1 PLANT SAMPLE

leaf samples [bay leaf, Tulasi, babul, neem, guava] were collected from the local area of Ahmedabad (Gujarat), India. Takin leaf →clean by water →drying in room temprature→making powder → store in air tight centenar →1.5g powder+15 ml water →heat by water bath in 30m →filter by paper → store for research in 4°c temperature

2.2SYNTHESIS OF NANOPARTICLES

2.2.1 SYNTHESIS OF CUSO4 NANOPARTICLES

Copper sulphate (CuSO4) nanoparticles were synthesized using a 2ml volume of bay plant extract mixed with a 20ml solution of 1mM copper sulphate. The mixture was left at room temperature for 24 hours. The appearance of a dark color indicated the formation of CuSO4 nanoparticles. The solution was then centrifuged at 3000 rpm for 15 minutes, and the pellet was re-dispersed in deionized water to remove any unwanted biological materials. After centrifugation, the pellet was washed with autoclaved distilled water 1-3 times to obtain nanoparticles.

2.2.2 CHARACTERIZATION OF CUSO4 NANOPARTICLES

UV-visible spectrophotometer was used to characterize the CuSO4 nanoparticles. A sample was prepared by combining 30 µl of bay copper (CuSO4) nanoparticles with 2 ml of distilled water, and the UV-visible spectrum of the solution was analyst The absorbance of the sample was measured at wavelengths between 200 and 400 nm. [9]

2.2.3 SYNTHESIS OF FESO4 NANOPARTICLES

Iron sulphate (FeSO4) nanoparticles were synthesized using a 2ml volume of plant extract mixed with a 20ml solution of 2mM ferrous sulphate. The mixture was stirred on a magnetic stirrer for 30 minutes at 500 rpm and then left at room temperature for 24 hours. The appearance of a dark color indicated the formation of FeSO4 nanoparticles. The solution was then centrifuged at 3000 rpm for 15 minutes, and the pellet was re-dispersed in deionized water to remove any unwanted biological materials. After centrifugation, the pellet was washed with autoclaved distilled water 1-3 times to obtain nanoparticles.

2.2.4 CHARACTERIZATION OF FESO4 NANOPARTICLES

UV-visible spectrophotometer was used to characterize the FeSO4 nanoparticles. A sample was prepared by combining 30 µl of Baboole iron (FeSO4) nanoparticles with 2 ml of distilled water, and the UV-visible spectrum of the solution was analyzed. The absorbance of the sample was measured at different wavelengths. [10]

2.3PHYTOCHEMICAL TEST

Phytochemicals are natural secondary metabolites produced by plants, which contribute to features like color, aroma, and flavor, and play essential roles in plant cell regulation. These compounds have significant medicinal value with minimal side effects.

2.3.1 FLAVONOIDS

Flavonoids are plant-derived compounds found in various parts of plants. They aid in growth and defines against plaques in vegetables and belong to a class of phenolic compounds distributed widely in the plant kingdom.

2.3.2 SAPONINS

Saponins are naturally occurring compounds found throughout legume plants. They form stable soap-like foams in aqueous solutions and constitute a diverse group of compounds.

2.3.3STEROIDS

Steroids act as growth hormones in plants.

2.3.4 TANNINS

Tannins are astringent polyphenolic compounds that bind and precipitate proteins, amino acids, alkaloids, and other organic substances.

2.3.5 QUINONES

Quinones are pigments found in various living organisms, existing in forms like benzoquinones, naphthoquinones, and anthraquinones.

2.3.6 TERPENOIDS

Terpenoids are a diverse class of organic compounds found in all living things, modifiable in numerous ways, and form the largest group of natural products.

2.3.7GLYCOSIDES

Glycosides are compounds convertible into sugars and no sugar components (aglycones or genius), including cardenolides, bufadienolides, amygdalin, anthraquinones, and salicin. [11]

2.4 COLLECTION AND SCREENING OF DENTAL SAMPLES FOR DENTAL CAVITY ISOLATES

SAMPLE COLLECTION

Dental samples were collected from individuals who underwent Root Canal Treatment (RCT) at a local dental clinic. Patients with contagious viral infections visiting the clinic were included in the study. Samples were collected in sterilized micro centrifuge tubes containing 1ml of sterile phosphate-buffered saline (PBS) and stored at -20°C for microbiological and molecular assays.

2.4.1 IDENTIFICATION OF TARGET PATHOGENS

Identify specific dental pathogens of interest, such as Streptococcus mutans, Porphyromonas gingivalis, Actinomyces spp., Fusobacterium spp., and Prevotella spp.

2.4.2 SOURCE OF ISOLATES

Obtain bacterial isolates from reputable sources like culture collections or clinical samples, such as the American Type Culture Collection (ATCC).

2.4.3CULTURE MEDIA AND CONDITIONS

Choose appropriate culture media and conditions for growing dental pathogens. Different pathogens may require specific media and incubation conditions.

2.4.4 ISOLATION AND PURIFICATION

Streak the bacterial isolate onto selected culture medium to obtain isolated colonies. Perform sub-culturing or purification steps if needed for obtaining pure cultures.

2.4.5 CHARACTERIZATION

Conduct preliminary characterization tests like Gram staining, colony morphology evaluation, and biochemical tests to confirm the identity of isolated strains.

2.4.6 STORAGE AND MAINTENANCE

Preserve isolated strains for long-term storage using methods like freezing cultures at -80°C or lyophilization (freeze-drying). [12]

2.4.7MICROBIOLOGICAL IDENTIFICATION

Isolate and identify oral pathogenic bacteria using selective media like NA AGAR and Cetrimide agar. Identify isolates based on colony morphology, pigment production, and oxidase tests.

2.5 PHENOTYPIC IDENTIFICATION

2.5.1GRAM STAINING

A Gram stain is a laboratory test that detects bacteria in suspected infection sites or bodily fluids. It provides quick results for identifying bacteria and guiding further tests and treatment options. [13]

2.6 BIOCHEMICAL TESTS

2.6.1 CATALASE TEST

Test identification → enzyme catalase→ [breakdown by hydrogen peroxide] →water + oxygen

Bubbles formed →positive result.

No bubbles → -ve

PROCEDURE

1. Place a small number of bacteria on a glass slide.
2. Add hydrogen peroxide to the bacteria.
3. Observe bubble formation.

2.6.2UREASE TEST

This test detects urease production, converting urea to ammonia and increasing PH. PROCEDURE

1. Mix urease and culture, incubate 24-48 hours.
2. Observe pH indicator change due to ammonia formation.

2.6.3 CITRATE AGAR TEST

This test determines citrate utilization as a carbon source by measuring pH change. PROCEDURE

1. Streak bacteria on citrate agar slant.
2. Incubate 4-7 days, observe colour change.

2.6.4 INDOLE TEST

This test assesses tryptophan degradation and indole production. PROCEDURE

1. Inoculate tryptophan broth.
2. Incubate, add Kovac's reagent, observe for a ring.

2.6.5CARBOHYDRATE FERMENTATION TEST

This test measures microorganisms' ability to ferment carbohydrates. PROCEDURE

1. Inoculate carbohydrate medium.
2. Incubate, observe for pH indicator colour change.

2.6.6GELATIN TEST

This test detects gelatinase production by bacteria. PROCEDURE

1. Inoculate gelatine deep.
2. Incubate, observe for liquefaction.

2.6.7 METHYL RED TEST

This test determines glucose fermentation pathway. PROCEDURE

1. Inoculate medium, incubate.
2. Add methyl red, observe for red colour.

2.6.8 VOGES-PROSKAUER TEST

This test detects acetyl methyl carbinol production from glucose fermentation. PROCEDURE

1. Inoculate medium, incubate.
2. Add α-naphthol, KOH, observe pink-red colour.

2.7 CONFIRMATORY TESTS

These tests use selective media to favour specific microorganisms' growth.

2.8ANTIMICROBIAL ACTIVITY

Screening synthesized nanoparticles against dental bacterial isolates (e.g., Staphylococcus) using nutrient agar and broth. Antibacterial activity determined by agar well diffusion method.

2.9MEDIA PREPARATION

Nutrient agar medium prepared by dissolving synthetic Nutrient agar powder in distilled water. Adjust pH to 6.8, autoclave, and transfer to Petri plates.

2.9.1AGAR-WELL DIFFUSION METHOD

Common technique to evaluate antibacterial activity. [14]

3 RESULTS

This is common knowledge that plants are rich in resources for creating different types of nanoparticles that are environmentally benign. In order to find a new plant-based method for the production of biologically active nanoparticles efforts have been conducted in the current research. Additionally, this study is focused on green technology to discover its additional benefits over chemical-based technology. It has benefited this research by being secure and environmentally sustainable.

3.1PLANT EXTRACTS

Plants are widely recognized as valuable sources for various applications, including the eco-friendly synthesis of five distinct plant-based nanoparticles. Consequently, this study aims to explore novel plant-derived systems for producing biologically active nanoparticles, emphasizing the advantages of green technology over chemical methods. The research capitalizes on its safety and eco-friendliness.

3.2 PHYTOCHEMICAL PROPERTIES

Table-1 presents an overview of the phytochemical characteristics of the five medicinal plants investigated. The table outlines the phytochemical attributes of these five therapeutic plants. The study revealed that these plants contain bioactive compounds with medicinal potential. The table demonstrates the presence of various components in these plants, such as phenols, tannins, terpenoids, flavonoids, saponins, glycosides, and quinones.

No	Name of Test	Guava	Tulasi	Neem	Baboole	Bay
1	Flavonoids	-	+++	+++	+++	+++
2	Saponins	+++	-	-	+++	+++
3	Steroids	+++	+++	+++	+++	-
4	Tannin	-	+++	+++	-	+++
5	Quinone	+++	+++	+++	+++	+++
6	Terpenoids	+++	+++	-	-	-
7	Glycoside	-	+++	+++	-	+++

Table phytochemical test five plant extract

Phytochemical test (a) Guava (b) Tulasi (c) Neem (d) Baboole (e) BAY

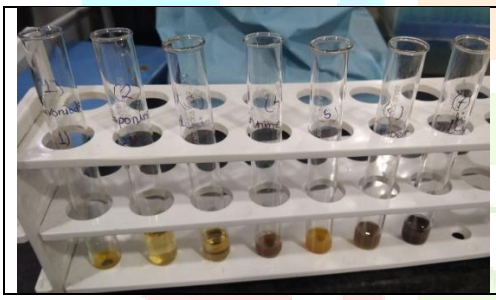

Fig (a) phytochemical test of guava Fig (b) phytochemical test of Tulasi leaf extractFig (c) phytochemical test of Neem extractFig (d) phytochemical test of Baboole extractFig (e) phytochemical test of bay leaf extract

3.3 BIOLOGICAL SYSTEM SCREENING AND SELECTION FOR COPPER AND IRON NANOPARTICLE SYNTHESIS

The potential of plant leaves in synthesizing copper and iron nanoparticles prompted the investigation of five distinct plant materials. These plant leaves were sourced from the Ahmedabad region in Gujarat. Following the methodology outlined in the Materials and Methods section, the fifth plant leaf was assessed for its capability to produce copper and iron nanoparticles. The results, as indicated in the Table, revealed that out of the five plant samples examined, only one produced copper and iron nanoparticles. The remaining plant system yielded Tulasi cuso4 nanoparticles. This observation was reinforced by the emergence of peaks within the 240–300 nm wavelength range and the discernible color change detected using a UV-visible spectrophotometer.

3.4 NANOPARTICLES

FIG- [A] Guava nanoparticle [B] Tulsi nanoparticle

FIG- [A] Neem nanoparticle [B] Babul nanoparticle

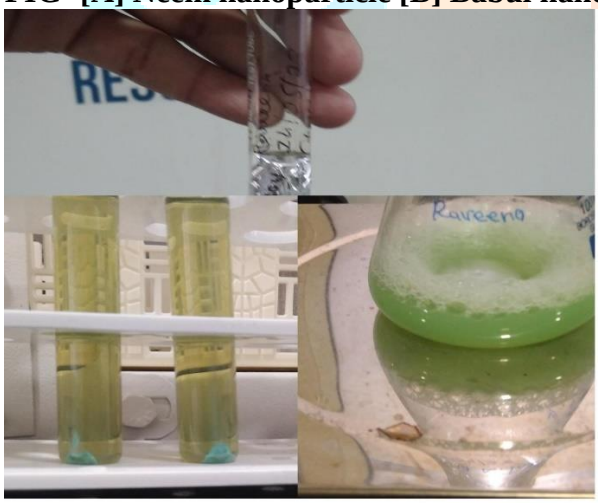

FIG [E]- Bay nanoparticle

Analysis of copper and iron nanoparticles produced by Tulasi Baboole guava bay leaf and Neem by UV-Vis's spectrophotometer

s.no	Plant name	Scientific name	Metal name	Rang	Metal name	Rang
1.	Tulasi	(Ocimum sanctum)	$Cuso_4$	520	$Feso_4$	450
2.	Neem	(Azadirachta indica)	$Cuso_4$	470	$Feso_4$	630
3.	Baboole	(Acacia nilotica)	$Cuso_4$	325	$Feso_4$	320
4.	Guava	(Psidium guajava)	$Cuso_4$	220	$Feso_4$	550
5.	Bay leaf	(Laurus nobilis)	$Cuso_4$	360	$Feso_4$	260

Table- plant nanoparticles & rang of nanoparticles

3.5 CHARACTERIZATION

Nanoparticles by UV-Visible absorption spectroscopy (UV Vis) Guava, Tulasi nanoparticle synthesis was visibly verified by the colour changing to black light away as shown in the previous figure. By using a UV-Visible spectrophotometer the nanoparticles were further examined and the creation of guava nanoparticles was verified. For several nanoparticles the average absorption peak ranged from 240 to 400 nm.

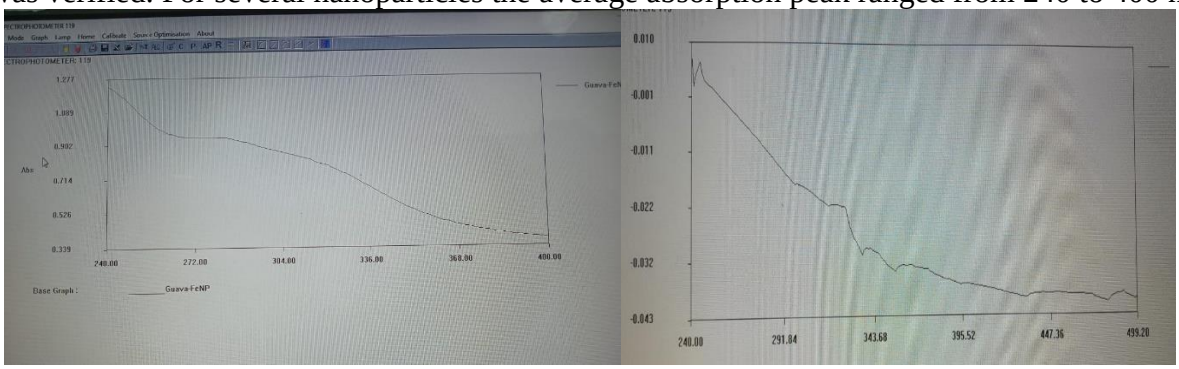

Fig reading of [a]guava and [b]Tulasi nanoparticle

Characterization of Copper Tulasi Nanoparticles using UV-Visible Absorption Spectroscopy (UV-Vis)

The shift in colour from light green to dark green that was previously observed strongly validated the conversion of metal from bay leaf, baboole, and neem into copper nanoparticles. The confirmation of copper nanoparticle production was carried out using a UV-Visible spectrophotometer, which offered further insights into the nanoparticles. The average absorption peak for various nanoparticles was found to fall within the range of 240 to 499 nm.

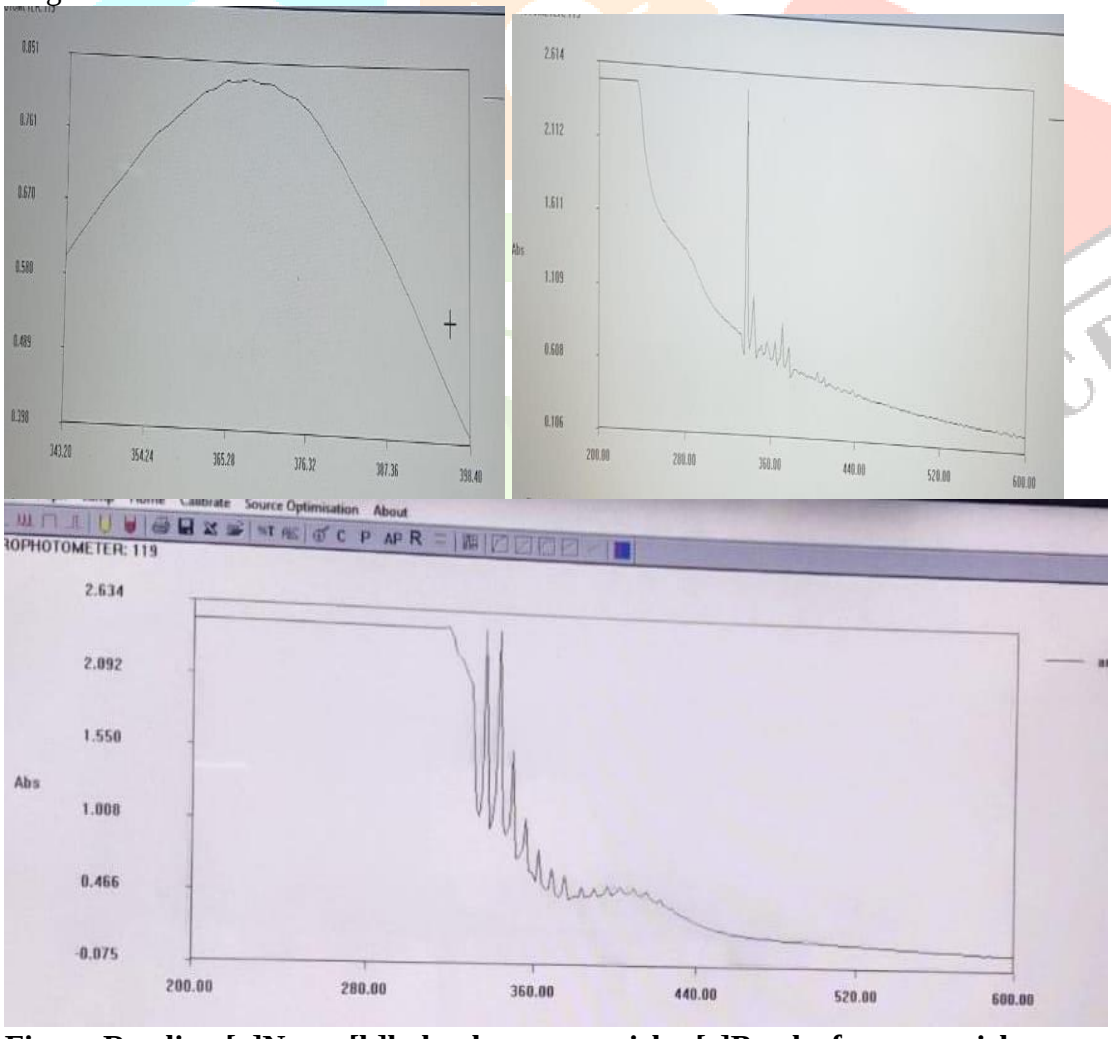

Figure Reading [a]Neem [b]baboole nanoparticles [c]Bay leaf nanoparticles

3.6 BIOCHEMICAL TEST

One of the more common approaches for identifying microorganisms is by biochemical testing which can often be combined with dental bacteria identification.

No	Dental sample	Result	Isolated bacteria
1	Tooth	+ve	Micrococcus luteus
2	Tooth	+ve	Enterococcus faecalis
3	Tooth	+ve	Staphylococcus simulans
4	Tooth	+ve	Cellobiosococcus lentus

Table 3-Isolate of dental bacteria

Following the isolation of the bacterium biochemical tests were conducted to identify the bacteria and the results are as follows.

Dental sample

No.	Name of test	1C1	1C2	1C3	1C4
1	Gram strain	+	+	+	+
2	Catalase	+	+	+	+
3	C F	+	+	+	+
4	Citrate	+	-	-	-
5	Methyl red	+	+	+	-
6	VP	-	-	-	-
7	Gelatine	+	-	-	-
8	Urease	+	-	+	-
9	Indole	-	-	-	-

Table 4 - of biochemical test

The biochemical test results for the aforementioned bacteria are shown in the following image.

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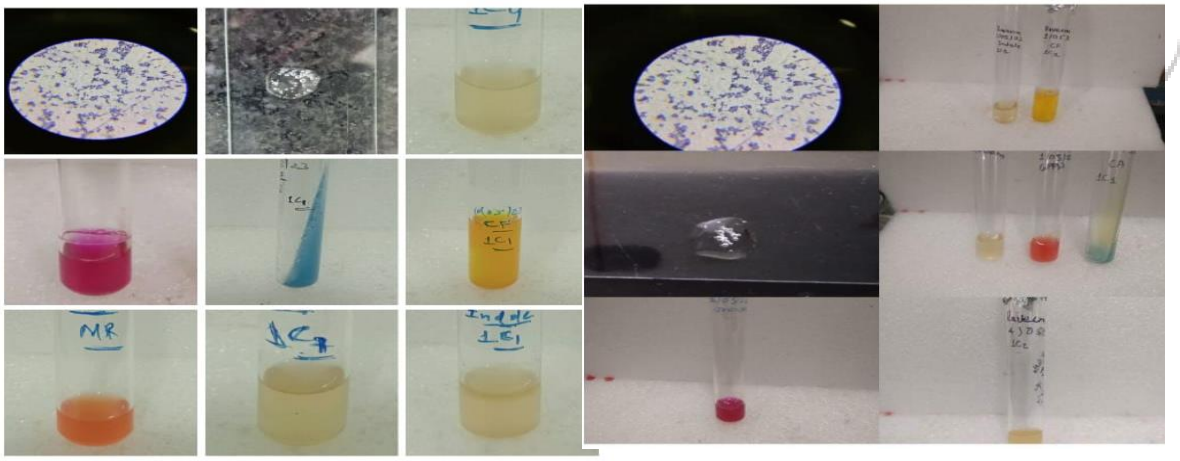


Figure -biochemical test

Confirmatory Test

The outcomes of the biochemical tests employed to identify the bacteria are further validated through a preliminary bacterial confirmation test. Specific selective media tailored for distinct species are used for this selective testing. In this experiment, MacConkey agar was employed to identify Proteus mirabilis and Citrobacter freundii, Brain Heart Infusion agar was used for identifying Streptococcus Agalactiae, and Mannitol Salt Agar was employed for the identification of S. aureus or Micrococcus.

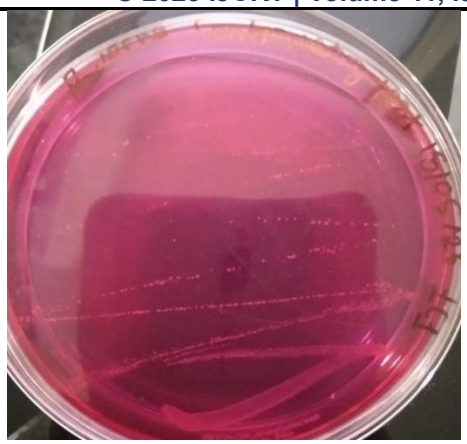
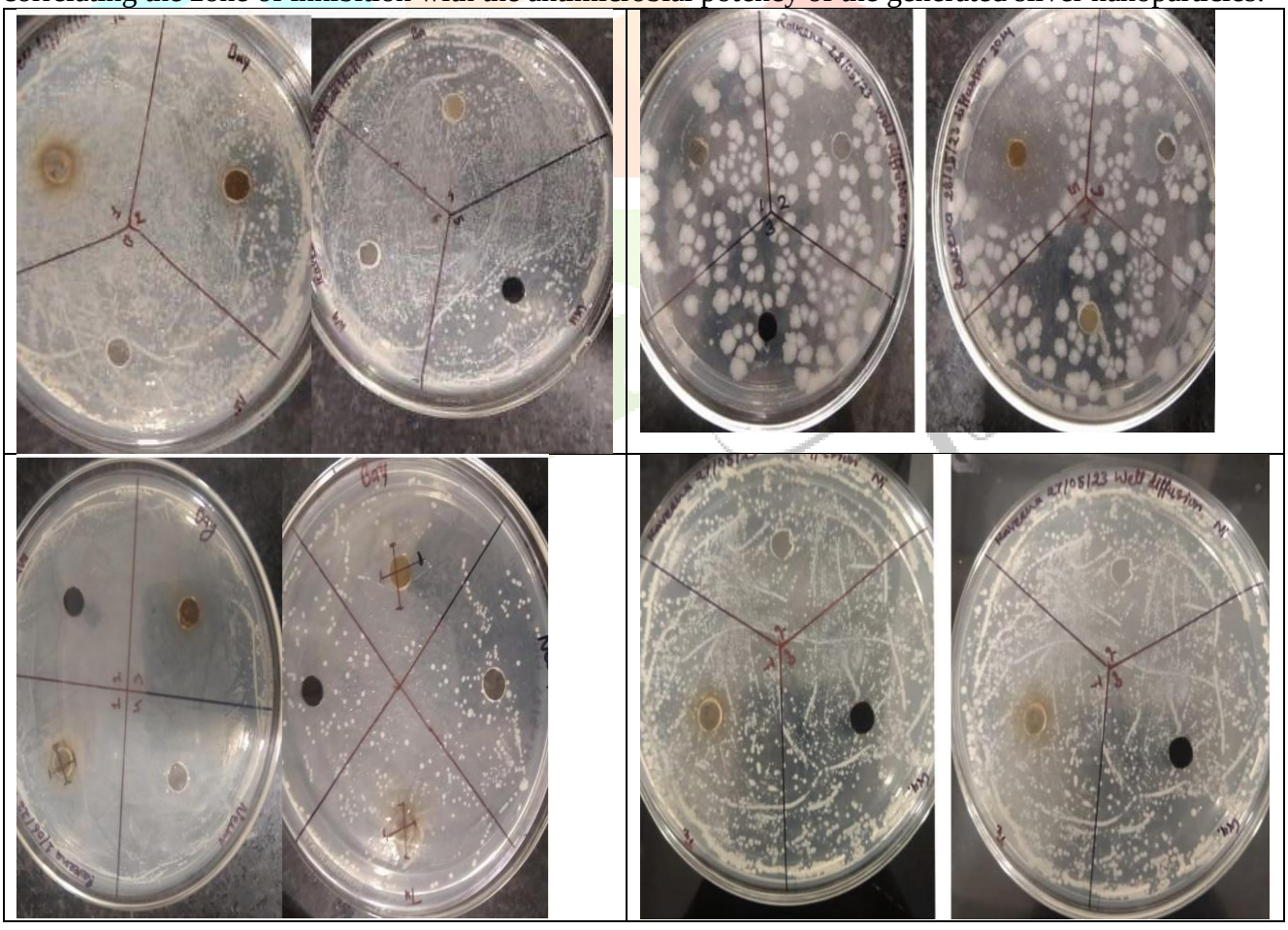


Figure- of confirmatory test

Antimicrobial Activity

The antimicrobial effectiveness of the synthesized copper and iron nanoparticles, along with Tulasi, bay, Neem, Baboole, and guava nanoparticles, was assessed against dental isolates such as S. aureus, Proteus mirabilis, Micrococcus, Streptococcus, and Citrobacter freundii. The suppression of microbial growth was measured through zones of inhibition, which were recorded at varying concentrations of copper, iron, Tulasi, and bay nanoparticle solutions.

The synthesized nanoparticles displayed varying degrees of antimicrobial activity against the tested microorganisms. This divergence in activity can be attributed to the distinct mechanisms engaged in microorganism eradication. The inhibition of microbial growth was visualized as zones of inhibition, and their respective diameters were determined. Statistical analysis was conducted to substantiate these findings, correlating the zone of inhibition with the antimicrobial potency of the generated silver nanoparticles.



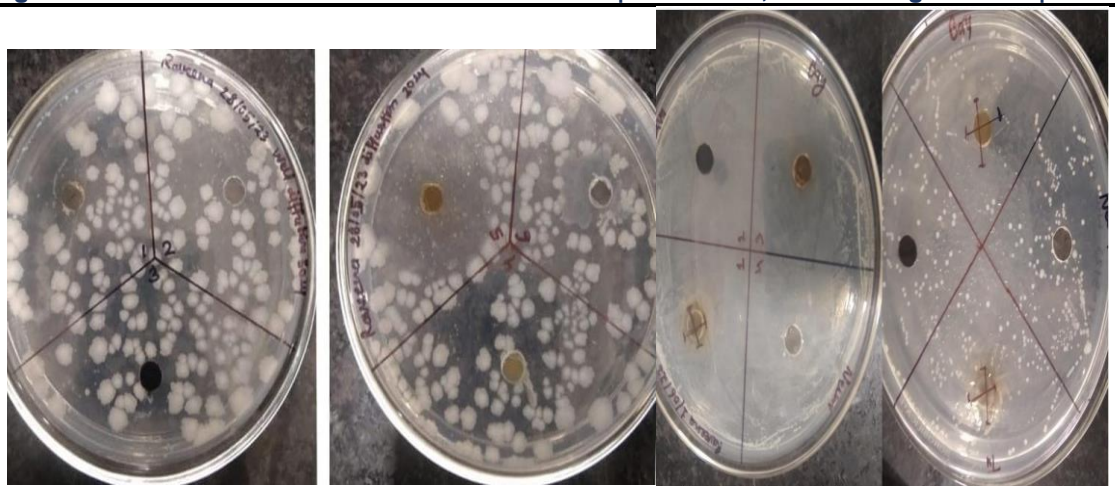


Figure- nanoparticle activity

Figure -all check nanoparticles on dental pathogens activity
To check activities of all nanoparticle on dental pathogen like us-
Micrococcus luteus
Enterococcus faecalis
Staphylococcus simulans
Cellobiosococcus lentus

4 ORAL FORMULATION

4.1COMPOSITION OF TOOTHPASTE FORMULATION
MATERIALS:

1. Xanthan Gum: Xanthan gum is derived from the bacterium Xanthomonas campestris, commonly found on certain Brassicaceae species. It produces a gummy exudate, xanthan "gum," a high-molecular-mass anionic polysaccharide. It can exist as sodium, potassium, or calcium salt. Industrial production involves bacterial culture on appropriately buffered and aerated media containing carbohydrates with Xanthomonas campestris.
2. Calcium Carbonate (CaCO3): This fine, white, order less, microcrystalline powder is practically insoluble in water. It's a long-standing abrasive used in toothpaste. It can be of heavy or precipitated type, derived from limestone or calcium hydroxide respectively. It remains stable against temperature and pH changes.
3. Sweeteners: Sweeteners enhance the taste of toothpastes and mouthwashes, giving them a mild and sweet flavour. Common sweeteners include sodium saccharin, sorbitol, glycerol, and xylitol, which also claims to provide anti-caries activity.
4. Sodium Alginate: Derived from algae like Laminaria, it's chiefly the sodium salt of alginic acid. It's a white or pale yellowish-white powder, slowly soluble in water, forming a viscous, colloidal solution. It's used as a suspending and thickening agent, particularly in the preparation of water-miscible pastes, creams, and gels.
5. Sodium Lauryl Sulphate (SLS): A mixture of sodium alkyl sulphates, mainly sodium dodecyl sulphate. It's a white or pale-yellow powder or crystals with a slight characteristic odor. It's soluble in water and partly soluble in alcohol. It's used for its foaming properties and cleaning ability in toothpaste but can be skin and mucosa irritant.
6. Glycerine: Glycerine acts as a humectant, retaining water to prevent toothpaste from drying out in the tube and maintaining moisture during brushing.

4.2 PROCESSES:

The toothpaste formulation aims to remove deposits from teeth and is meant to be used simultaneously with a toothbrush. It serves as a non-sterile aqueous solution with deodorant, refreshing, or antiseptic effects, known as mouthwash.

10µl Tulasi Cuso4 nanoparticles,10µl bay leaf Cuso4 nanoparticles, Xanthan gum 0.5 g Calcium carbonate 5g, Sugar 1g, Sodium chloride 0.5gGlycerine 2.5ml, Sodium lauryl sulphate 0.25g, Distilled water 5ml

Figure-TOOTH PASTE FORMULATION

5 DISCUSSIONS

In recent years the escalating problem of antibiotic resistance among dental pathogens has posed significant challenges in the field of dentistry. To combat this issue researchers have been exploring alternative approaches such as the utilization of nanoparticles (NPs) with antimicrobial properties. Additionally, the synthesis of these NPs through green methods using natural sources has gained attention due to its eco-friendly and sustainable nature.

This introduction will provide an overview of the topic highlighting the antimicrobial potential of green synthesized nanoparticles on dental pathogens and the development of oral formulations. Green synthesis involves employing plant extracts microorganisms or other natural sources as reducing and stabilizing agents for the production of nanoparticles. This method offers several advantages over conventional synthesis approaches including cost-effectiveness biocompatibility and the ability to produce NPs with diverse antimicrobial properties.

6 CONCLUSIONS

Oral health plays a pivotal role in overall well-being. Adverse oral health can significantly impact systemic health, quality of life, and a nation's economic productivity. India grapples with the burden of oral diseases like oral cancers, dental caries, and periodontal diseases. It's crucial for individuals to actively contribute, as not everything can solely rely on government efforts.

For any disease, factors can be categorized as congenital or hereditary, behavioural, and environmental. In the context of oral health, the latter two factors hold paramount importance.

Dental caries, a disease triggered by sugar, can be prevented and controlled by modifying dietary habits. Reducing refined sugar intake among individuals and communities is a key preventive measure. The practice of oral hygiene, including teeth cleaning, is closely associated with the prevalence of periodontal disease among individuals.

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