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Anticariogenic Activity of Avocado Seed Extract Mediated Synthesis of Selenium Nanoparticle.

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ABSTRACT

Background: Dental caries is a multifactorial infectious disease resulting from the interaction between cariogenic bacteria, fermentable carbohydrates, and host factors. Aim: The aim of the study is to study the Anticariogenic Activity of Avocado Seed Extract Mediated Synthesis of Selenium Nanoparticle. Method:Fresh avocado fruits were collected and the seeds were separated, washed thoroughly, and air-dried. The dried seeds were powdered using a mechanical grinder. Approximately 10 g of seed powder was mixed with 100 mL of distilled water and heated at 60–70°C for 20 minutes. The mixture was filtered using Whatman No.1 filter paper to obtain a clear extract, which was stored at 4°C for further use. Results: The synthesized selenium nanoparticles exhibited measurable antimicrobial activity against all tested organisms. A concentration-dependent increase in inhibition was observed particularly against Staphylococcus aureus and Candida albicans. The highest inhibition was observed against Candida albicans at 100 µL with a zone of 13 mm. However, comparatively lower activity was observed against Enterococcus faecalis and Streptococcus mutans. Conclusion: This study demonstrates that selenium nanoparticles can be successfully synthesized using avocado seed extract through a green and eco-friendly method. The synthesized nanoparticles exhibited antimicrobial activity against important oral pathogens including Staphylococcus aureus, Enterococcus faecalis, Streptococcus mutans, and Candida albicans..

Keywords: *selenium nanoparticles, avocado seed, green synthesis, anti cancer activity*.

INTRODUCTION

Dental caries is a multifactorial infectious disease resulting from the interaction between cariogenic bacteria, fermentable carbohydrates, and host factors. Among oral pathogens, Streptococcus mutans plays a key role in the initiation of dental caries due to its acidogenic and aciduric properties. Other microorganisms such as Enterococcus faecalis, Staphylococcus aureus, and the opportunistic fungal pathogen Candida albicans are also associated with oral infections, root canal failures, and oral candidiasis.

Conventional antimicrobial agents are widely used to control oral pathogens; however, the emergence of antimicrobial resistance and potential side effects have encouraged the search for alternative therapeutic approaches. Nanotechnology has emerged as a promising field in biomedical research, particularly for the development of novel antimicrobial agents.

Selenium nanoparticles (SeNPs) have attracted significant attention due to their unique physicochemical properties, biocompatibility, and strong antimicrobial activity. Compared with bulk selenium, nanoscale selenium exhibits enhanced biological activity and reduced toxicity.

Green synthesis of nanoparticles using plant extracts has become a preferred method because it is environmentally friendly, cost-effective, and avoids toxic chemicals. Plant extracts contain bioactive compounds such as polyphenols, flavonoids, and antioxidants that act as reducing and stabilizing agents during nanoparticle synthesis.

Avocado (Persea americana) seeds are rich in phytochemicals including phenolic compounds, flavonoids, and tannins that exhibit antimicrobial and antioxidant properties. Despite these beneficial components, avocado seeds are often considered agricultural waste. Utilizing avocado seed extract for nanoparticle synthesis provides both environmental and biomedical advantages.

Therefore, the present study aimed to synthesize selenium nanoparticles using avocado seed extract and evaluate their anticariogenic and antimicrobial activity against selected oral pathogens.

MATERIALS AND METHODS

Preparation of Avocado Seed Extract

Fresh avocado fruits were collected and the seeds were separated, washed thoroughly, and air-dried. The dried seeds were powdered using a mechanical grinder. Approximately 10 g of seed powder was mixed with 100 mL of distilled water and heated at 60–70°C for 20 minutes. The mixture was filtered using Whatman No.1 filter paper to obtain a clear extract, which was stored at 4°C for further use.

Green Synthesis of Selenium Nanoparticles

Selenium nanoparticles were synthesized using sodium selenite as a precursor. A specific volume of avocado seed extract was added dropwise to the sodium selenite solution under continuous stirring. The mixture was incubated until a visible color change occurred, indicating the formation of selenium nanoparticles. The synthesized nanoparticles were centrifuged, washed with distilled water, and stored for further analysis.

Test Microorganisms

The antimicrobial activity of the synthesized nanoparticles was evaluated against the following oral pathogens:

Staphylococcus aureus

Enterococcus faecalis

Streptococcus mutans

Candida albicans

These microorganisms are commonly associated with dental caries and oral infections.

Antimicrobial Activity Assay

The antimicrobial activity was determined using the agar well diffusion method. Mueller–Hinton agar plates were prepared and inoculated with microbial cultures using sterile cotton swabs. Wells were created using a sterile cork borer.

Different concentrations of selenium nanoparticles (25 µL, 50 µL, and 100 µL) were added to the wells. A standard antibiotic was used as a positive control. The plates were incubated at 37°C for 48–72 hours. After incubation, the zones of inhibition were measured in millimeters.

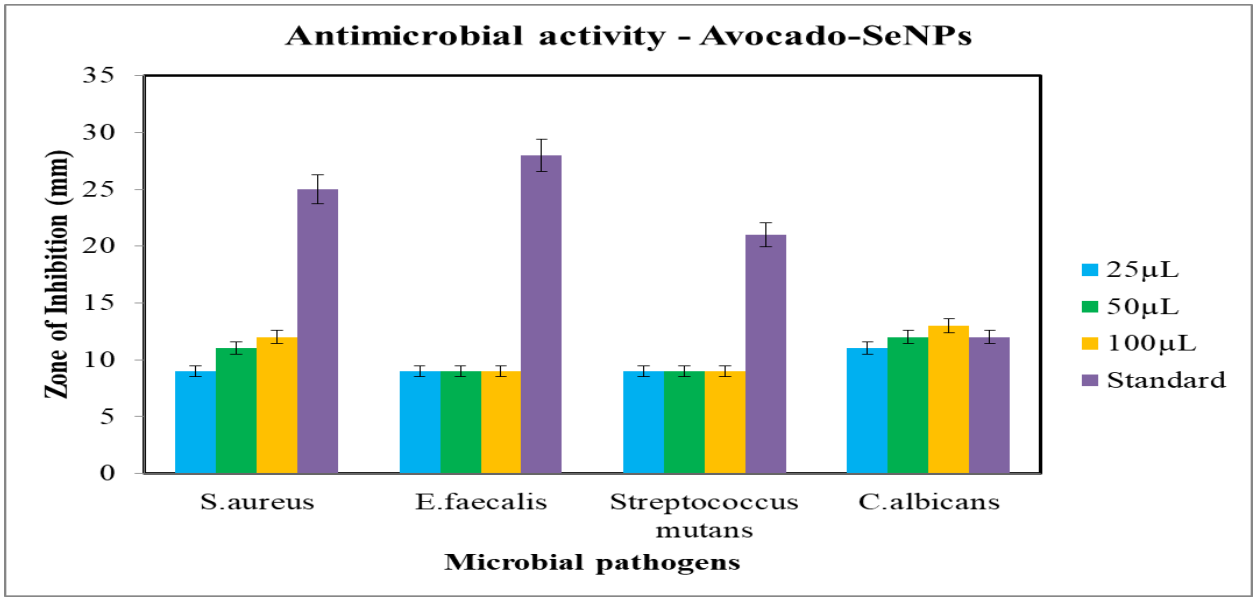
Results

The antimicrobial activity of avocado seed-mediated selenium nanoparticles was evaluated against four microbial pathogens. The results are summarized in Table 1.

Table 1: Antimicrobial activity of Avocado-SeNPs (Zone of inhibition in mm)

	25mcl	50 mcl	100 mcl	Ab
S. Aureus	9	11	12	40
S. Mutants	9	9	9	21
E. Faecalis	9	9	9	28
C. Albicans	11	12	13	12

The synthesized selenium nanoparticles exhibited measurable antimicrobial activity against all tested organisms. A concentration-dependent increase in inhibition was observed particularly against Staphylococcus aureus and Candida albicans. The highest inhibition was observed against Candida albicans at 100 µL with a zone of 13 mm. However, comparatively lower activity was observed against Enterococcus faecalis and Streptococcus mutans.



DISCUSSION

The present study demonstrates the successful synthesis of selenium nanoparticles using avocado seed extract through a green synthesis approach. Plant-mediated synthesis is advantageous because phytochemicals present in the extract act as natural reducing and stabilizing agents.

The antimicrobial results indicate that the synthesized nanoparticles possess significant inhibitory effects against oral pathogens. The observed antimicrobial activity may be attributed to several mechanisms including disruption of microbial cell membranes, generation of reactive oxygen species, and interference with microbial metabolic pathways.

Among the tested organisms, Candida albicans showed the highest susceptibility to selenium nanoparticles. This suggests potential antifungal applications in the treatment of oral candidiasis. Moderate inhibition was observed against Staphylococcus aureus, indicating antibacterial properties of the nanoparticles.

However, lower inhibition zones were observed against Enterococcus faecalis and Streptococcus mutans, which may be due to the inherent resistance of these bacteria or differences in cell wall structure. Despite this, the nanoparticles still demonstrated measurable antimicrobial activity, indicating potential applications in caries prevention strategies.

Previous studies have reported that selenium nanoparticles possess strong antimicrobial and antioxidant properties. The presence of phytochemicals from avocado seeds may further enhance their biological activity through synergistic effects.

CONCLUSION

This study demonstrates that selenium nanoparticles can be successfully synthesized using avocado seed extract through a green and eco-friendly method. The synthesized nanoparticles exhibited antimicrobial activity against important oral pathogens including Staphylococcus aureus, Enterococcus faecalis, Streptococcus mutans, and Candida albicans. The results suggest that avocado seed-mediated selenium nanoparticles possess promising anticariogenic potential and may serve as a novel therapeutic agent in dental and oral healthcare applications.

Further studies involving nanoparticle characterization, cytotoxicity evaluation, and clinical investigations are required to validate their potential for biomedical and dental applications

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