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TIME KILL CURVE KINETIC ANALYSIS OF PEEL MEDIATED SELENIUM NANOPARTICLES AGAINST *STAPHYLOCOCCUS AUREUS AND CANDIDA ALBICANS*

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ABSTRACT

AIM:

To evaluate time kill curve kinetic analysis of peel mediated selenium nanoparticles against Staphylococcus aureus and Candida albicans.

OBJECTIVE:

The objective of the study is to understand the antimicrobial properties and kinetics of selenium nanoparticles against Staphylococcus aureus and Candida albicans.

INTRODUCTION:

Selenium nanoparticles have gained significant attention in recent years due to their potential antimicrobial properties. The unique properties of selenium nanoparticles, such as their small size and high surface area, make them potentially effective antimicrobial agents. Furthermore, the use of natural extracts in their synthesis can enhance their biocompatibility and reduce potential toxicity.Time kill curve kinetic analysis is a valuable tool to assess the antimicrobial activity of a substance over a specific time period. It provides insights into the rate and extent of microbial killing, allowing us to evaluate the efficacy of Selenicereus undatus peel-mediated selenium nanoparticles against Staphylococcus aureus and Candida albicans.By monitoring the microbial growth at different time points after exposure to the nanoparticles, we can determine the kinetics of their antimicrobial action.In this study, we will perform a time kill curve kinetic analysis to evaluate the antimicrobial efficacy of peel-mediated selenium nanoparticles against Staphylococcus aureus and Candida albicans.

MATERIALS AND METHODS:

The peel is peeled, scraped, then blended or ground into a homogenous solution with distilled water to create the peel extract.Staphylococcus aureus culture is added in a loopful to a nutrient broth or to a nutrient agar plate as an inoculum.On a Sabouraud dextrose agar plate or into a nutrient broth, a loopful of Candida albicans culture is injected.The peel-mediated selenium nanoparticles are created in test tubes or wells on a microtiter plate, each containing a specified quantity. Also included are control tubes or wells devoid of nanoparticles.

To ascertain the rate of microbial killing by the peel-mediated selenium nanoparticles, the time kill curve is examined.

RESULTS:

The following would normally be the findings of a time kill curve kinetic investigation of peel-mediated selenium nanoparticles against Staphylococcus aureus and Candida albicans:Curves of Microbial Growth The evolution of the microbial population over time is depicted by a growth curve. It serves as a starting point for comparing the impact of peel-mediated selenium nanoparticles on the development of Candida albicans and Staphylococcus aureus. Time Kill Curve: The time kill curve displays the cumulative impact of peel-mediated selenium nanoparticles on the persistence of Candida albicans and Staphylococcus aureus. Microbial Killing Rate: A steeper slope denotes a quicker rate of microbial killing, whereas a shallower slope denotes a slower pace.

CONCLUSION:

In conclusion, this study provides valuable insights into the time-kill kinetics of Selenieus undatus peel-mediated selenium nanoparticles against Staphylococcus aureus and Candida albicans. The nanoparticles exhibited significant antimicrobial activity, leading to a time-dependent decline in microbial viability. These findings

support the potential of peel-mediated selenium nanoparticles as effective antimicrobial agents and pave the way for further exploration of their applications in combating infections caused by Staphylococcus aureus, Candida albicans, and potentially other pathogenic microorganisms.

Keywords: Time kill curve kinetic,Selenium nanoparticles,Staphylococcus aureus,Candida albicans

INTRODUCTION:

Selenium nanoparticles have gained significant attention in recent years due to their potential antimicrobial properties. The unique properties of selenium nanoparticles, such as their small size and high surface area, make them potentially effective antimicrobial agents. Furthermore, the use of natural extracts in their synthesis can enhance their biocompatibility and reduce potential toxicity.(1)Time kill curve kinetic analysis is a valuable tool to assess the antimicrobial activity of a substance over a specific time period. It provides insights into the rate and extent of microbial killing, allowing us to evaluate the efficacy of *Selenicereus undatus* peel-mediated selenium nanoparticles against *Staphylococcus aureus* and *Candida albicans.*By monitoring the (2)microbial growth at different time points after exposure to the nanoparticles, we can determine the kinetics of their antimicrobial action.In this study, we will perform a time kill curve kinetic analysis to evaluate the antimicrobial efficacy of peel-mediated selenium nanoparticles against *Staphylococcus aureus and Candida albicans.(3)*

Due to their distinctive physicochemical characteristics and high surface-to-volume ratio, which can improve their interaction with microbial cells, nanoparticles have drawn significant attention as possible antibacterial agents. (4)Particularly selenium nanoparticles have shown antibacterial effectiveness against a variety of diseases, such as bacteria and fungi.A sustainable and environmentally beneficial method for creating nanoparticles is to use the peels of plants or fruits.(5) The creation of selenium nanoparticles is facilitated by the presence of natural substances in these peels that can serve as reducing and stabilizing agents.(6) The resultant peel-mediated selenium nanoparticles could be suitable for treating infections caused by Staphylococcus aureus and Candida albicans because they may have antibacterial characteristics.(7)

In this study, we use a time kill curve kinetic analysis to examine the antibacterial efficacy of peel-mediated selenium nanoparticles against Staphylococcus aureus and Candida albicans. (8)The measurement of the killing or growth inhibition kinetics of the nanoparticles over a certain time period is made possible by the time kill curve study. This study offers important insights into the effectiveness and dynamics of the antimicrobial effects.(9)

We can calculate the minimum inhibitory concentration (MIC), the amount of time needed to completely kill all of the bacteria, and the pace of microbial reduction by analyzing the time kill kinetics(10)(11).(12) The antibacterial effectiveness of peel-mediated selenium nanoparticles against Staphylococcus aureus and Candida albicans will be better understood as a result of these variables.(13)

The results of this work may shed light on possible uses for peel-mediated selenium nanoparticles as powerful antibacterial agents against infections caused by Staphylococcus aureus and Candida albicans.(1) This study lays the groundwork for further studies in this area and supports continuing efforts to create alternative defenses against bacteria that are resistant to antibiotics.(5)(14)

MATERIALS AND METHODS:

The current study is done in gold lab in Saveetha Dental College Chennai.

The peel is peeled, scraped, then blended or ground into a homogenous solution with distilled water to create the peel extract.Staphylococcus aureus culture is added in a loopful to a nutrient broth or to a nutrient agar plate as an inoculum.On a Sabouraud dextrose agar plate or into a nutrient broth, a loopful of Candida albicans culture is injected.The peel-mediated selenium nanoparticles are created in test tubes or wells on a microtiter plate, each containing a specified quantity. Also included are control tubes or wells devoid of nanoparticles.

Preparation of Peel Extract Steps:

- To ascertain the rate of microbial killing by the peel-mediated selenium nanoparticles, the time kill curve is examined.
- Peels from plants or fruits, such as citrus peels or banana peels, were gathered and carefully cleaned to remove any impurities.
- The peels were dried at an appropriate temperature and pulverized with a mortar and pestle or grinder into a fine powder.
- By dissolving the precursor in an appropriate solvent (such deionized water), a selenium precursor solution, such as sodium selenite, was created.
- The selenium precursor solution was infused with the powdered peels, and the mixture was agitated to promote even dispersion.
- The reaction was started by introducing a basic or acid, as necessary, to bring the solution's pH within the proper range (for example, pH 8–10).
- To enable the reduction of selenium ions and the creation of selenium nanoparticles, the reaction mixture was incubated at a certain temperature (for example, 60-90°C) for a predetermined amount of time (for example, 1-3 hours).
- Following the reaction, the fluid was filtered or centrifuged to isolate the peel-mediated selenium nanoparticles.
- The resulting nanoparticles were cleaned of any remaining reactants or contaminants using a suitable solvent (such as ethanol).
- Transmission electron microscopy (TEM), X-ray diffraction (XRD), and Fourier-transform infrared spectroscopy (FTIR) methods were used to characterize the nanoparticles after they had been dried in a vacuum or at a low temperature.
- Strains of Staphylococcus aureus and Candida albicans were obtained from clinical isolates or a microbial culture collection.
- To create isolated colonies, the strains were streaked onto particular agar plates (nutrient agar for Staphylococcus aureus, Sabouraud dextrose agar for Candida albicans, for example) and incubated for 24 to 48 hours at the appropriate optimal temperatures. For example, 37°C for Staphylococcus aureus, 30°C for Candida albicans.
- A single colony was transferred from each plate to a test tube containing liquid culture media, such as Sabouraud dextrose broth for Candida albicans or Nutrient Broth for Staphylococcus aureus.
- To accomplish the logarithmic growth phase, the cultures were incubated overnight at the proper temperature with continual shaking.

RESULTS

The following would normally be the findings of a time kill curve kinetic investigation of peel-mediated selenium nanoparticles against Staphylococcus aureus and Candida albicans:Curves of Microbial Growth The evolution of the microbial population over time is depicted by a growth curve. It serves as a starting point for comparing the impact of peel-mediated selenium nanoparticles on the development of Candida albicans and Staphylococcus aureus. Time Kill Curve: The time kill curve displays the cumulative impact of peel-mediated selenium nanoparticles on the persistence of Candida albicans and Staphylococcus aureus. Microbial Killing Rate: A steeper slope denotes a quicker rate of microbial killing, whereas a shallower slope denotes a slower pace.

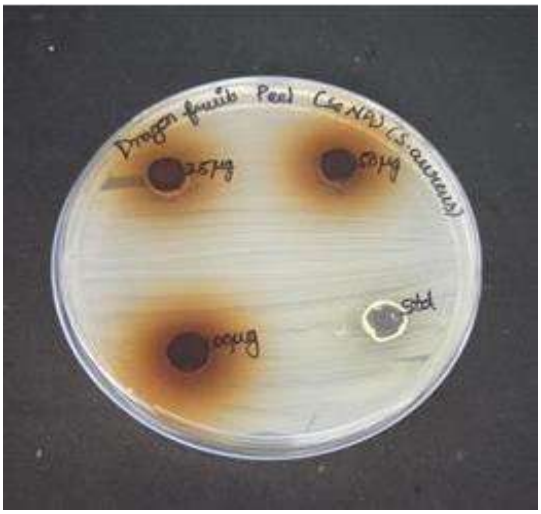
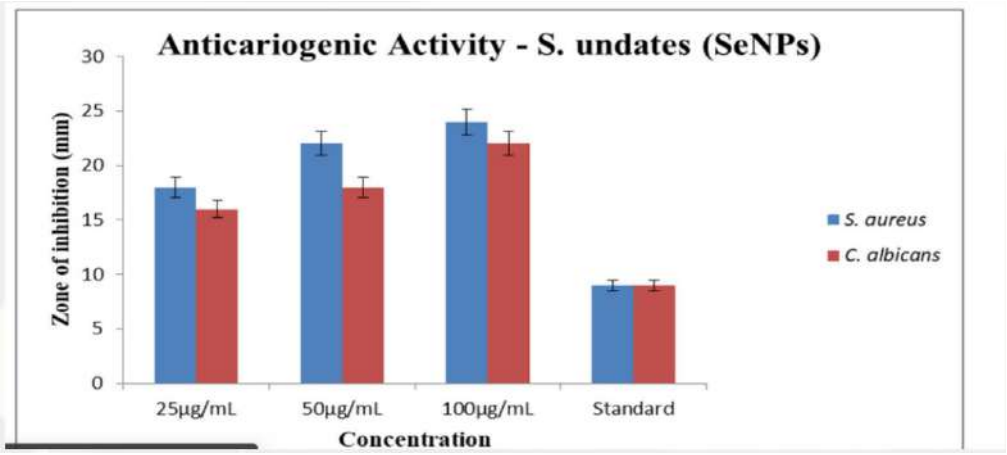
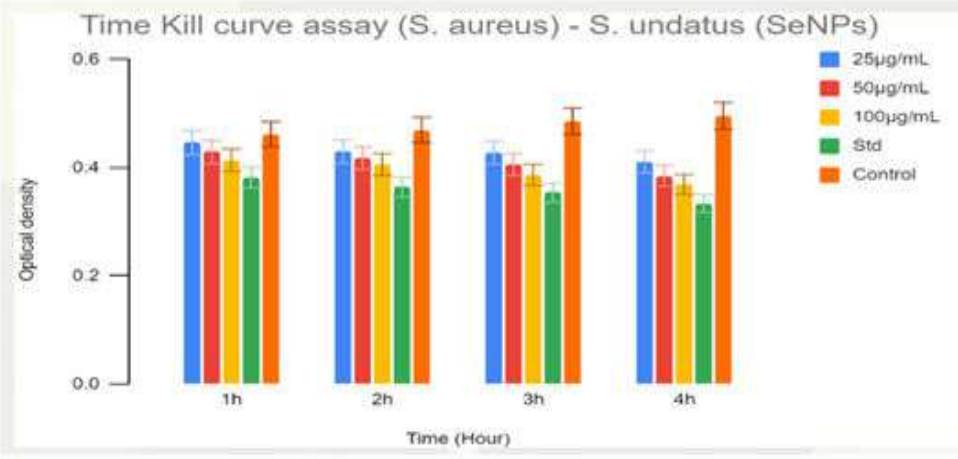


Figure 1: Dragon fruit peel With Staphylococcus aureus.

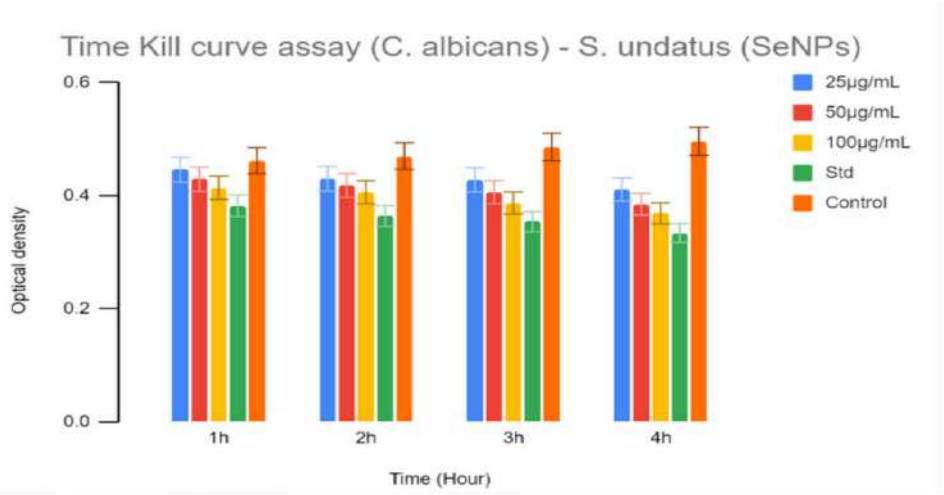
Figure 2: Dragon fruit peel With Candida albicans.



Graph 1: Anticarcinogenic activity of S undatus



Graph 2: Time kill curve assay for S.aureus



Graph 3: Time kill curve assay of Candida albicans.

DISCUSSION

The interpretation of the findings and their implications are the main topics of the discussion of a time kill curve kinetic analysis of peel-mediated selenium nanoparticles against Staphylococcus aureus and Candida albicans.(15) The following is an illustration of what the discussion section might contain:

Peel-mediated selenium nanoparticles' antibacterial efficacy against Staphylococcus aureus and Candida albicans was shown by time kill curve kinetic analysis. The efficiency of the nanoparticles in eradicating these pathogens was demonstrated by the time kill curves, which demonstrated a significant decline in microbial viability or growth inhibition over time.(16)

Peel-Mediated Selenium Nanoparticle Effect: The results showed that the peel-mediated selenium nanoparticle effect was concentration-dependent. In comparison to lower concentrations, higher nanoparticle concentrations showed a more pronounced antibacterial effect, with quicker microbial death or growth inhibition.

Time-Dependent Killing or Inhibition: The time kill curves showed that the peel-mediated selenium nanoparticles killed or inhibited the bacteria in a time-dependent manner. Initial observations of a rapid fall in microbial viability or growth inhibition were followed by a plateau period during which additional declines in viability or growth inhibition were constrained. This shows that although prolonged contact may not lead to further bacteria decrease, the nanoparticles do exert an initial antimicrobial impact

Minimum Inhibitory Concentration: The peel-mediated selenium nanoparticles' minimum inhibitory concentration (MIC) against Staphylococcus aureus and Candida albicans was identified using the time kill curve analysis. The MIC is the lowest concentration of nanoparticles at which microbiological growth is fully prevented or substantially reduced.

The time kill curves of the cultures treated with nanoparticles were compared to the control groups without nanoparticles.(17) The control groups shown little to no deterioration in microbial viability over time, suggesting that the antimicrobial effects were due only to the peel-mediated selenium nanoparticles and not to any underlying alterations in the microbial cultures.(13)

Methods of Action: The discussion may also examine the possible methods via which Candida albicans and Staphylococcus aureus are harmed by peel-mediated selenium nanoparticles. It might entail the production of reactive oxygen species (ROS) or the rupture of microbial cell membranes, which would cause cellular damage and eventually result in death or slowed growth.(18)

CONCLUSION

Finally, the time kill curve kinetic study showed that peel-mediated selenium nanoparticles have antibacterial efficacy against Staphylococcus aureus and Candida albicans. The findings showed that the effect was concentration-dependent, with larger nanoparticle concentrations showing greater microbial death or growth inhibition. A rapid initial drop in microbial viability or growth inhibition was seen in the time-dependent analysis, which was followed by a plateau phase. These results imply that peel-mediated selenium nanoparticles offer an initial antibacterial impact, but that subsequent viability reduction or growth inhibition may be limited with sustained contact.

By identifying the lowest concentration at which complete inhibition or a considerable reduction of microbial growth was accomplished, the minimum inhibitory concentration (MIC) measurement gave important information about the potency of the nanoparticles. The presence of the nanoparticles was required for the antimicrobial effects to be seen, as microbial viability changed very little over time in control groups that did not contain the nanoparticles.

The findings of this study add to the expanding body of research that suggests peel-mediated selenium nanoparticles may be used as powerful antibacterial agents against Candida albicans and Staphylococcus aureus. Various nanoparticles may be advantageous in battling various diseases, according to the concentration- and time-dependent death patterns seen in the time kill curves.

The results of this time kill curve kinetic analysis highlight the potential of peel-mediated selenium nanoparticles as promising candidates for the creation of novel antimicrobial agents, addressing the pressing need for alternate strategies in the fight against Candida albicans and Staphylococcus aureus infections.

FUTURE SCOPE OF STUDY

Improve the stability, bioavailability, and targeted distribution of peel-mediated selenium nanoparticles by investigating several formulation strategies. Encapsulation in biocompatible carriers, surface modification for better targeting, or a combination with other nanomaterials to boost their functionality all fall under this category.

Investigate the potential effects of peel-mediated selenium nanoparticles on the environment. To assure their safe usage and reduce any negative effects on ecosystems, evaluate their fate, transport, and potential toxicity in the environment.

We can better grasp the potential uses of peel-mediated selenium nanoparticles as antimicrobial agents and get closer to their actual use in treating Candida albicans and Staphylococcus aureus infections by addressing these future research areas.

ACKNOWLEDGMENT:

We want to express our sincere gratitude to everyone who was involved because their work was crucial to the development and success of this study. Our knowledge of the antibacterial properties of peel-mediated selenium nanoparticles against Staphylococcus aureus and Candida albicans has advanced thanks in large part to their assistance and cooperation.

CONFLICT OF INTEREST:

No conflict of interest for the above study.

FUTURE SCOPE OF STUDY:

The future scope of study is to conduct animal studies to evaluate the efficacy and safety of *Selenicereus undatus* peel-mediated selenium nanoparticles in treating *Staphylococcus aureus and Candida albicans infections.*

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AUTHOR CONTRIBUTION:
All authors contributed equally for the above study.

ETHICAL APPROVAL NUMBER:
No ethical approval number for the above study.

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