Journal of Health Care and Prevention

Research Article Open Access

Mechanisms of Action of Antimicrobial Agents against Bacterial

Dr. Akhavan Clara*

Departments of Neurosurgery, University of Medicine and Pharmacy, Iasi, Iran

Abstract

Acetonitrile was used as the solvent in the deposition-precipitation process for the synthesis of ZnO-SiO2 nanocomposite. Different analytical methods, such as Fournier Transformation Infrared Spectroscopy (FT-IR), Thermo-Gravimetric Analysis (TGA), Powder X-ray Diffraction (XRD), Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), and Dynamic Light Scattering (DLS), were used to characterise the synthesised nanocomposite. Utilising the Disc Diffusion technique and the Agar Well Diffusion Assay, respectively, biological potential including antibacterial and antifungal activities were also examined. By using TEM calculations, the particle size of the ZnO-SiO_2 nanocomposite was discovered to be 6.2 nm. The antifungal activity of the nanocomposite was inferior to that of the bacteria.

Keywords: Bacteria; Nanoparticles; Zinc oxide powder

Introduction

Nanoparticles may be effective antibacterial agents, according to a number of studies. Due to its antibacterial qualities, zinc oxide powder has been utilised as an active ingredient in ointments, creams, and lotions for skin treatments. However, zinc oxide nanoparticles are far more successful at preventing the growth of microorganisms. Additionally, the characteristics of particles are significantly altered at the nanoscale, improving their semiconducting capabilities as well as their effectiveness in preventing bacterial growth. The majority of the biosphere's components are microorganisms, and the proliferation of these organisms can either have a positive or negative impact on the environment for humans. The human body and the environment are symmetrical by nature. Therefore, it's important to prevent their growth in order to regulate their negative effects. Chemical substances known as antimicrobial agents have the ability to either inactivate or prevent the growth of microorganisms. These antimicrobial substances have a wide range of uses, including in the preservation and packaging of food, healthcare, water purification, textiles, and medical implants. Due to its appealing material features and applications in numerous domains, including photo-catalysis, organic pollutants, optical devices, antibacterial coatings, and sensors, nanotechnology is also gaining interest[4]. The ability to create metal oxide nanoparticles with precise shape and size is one area where nanotechnology is advancing and will likely lead to the creation of new antibacterial compounds. Metal oxide nanoparticles of various types have been created and are effective inhibitors of a variety of bacterial strains. The bacterial strains have a direct impact on the activity of nanoparticles. Metal oxides are used in a wide variety of products, including sensors, fuel cells, microelectronic circuits, and catalysis. The ability of metal oxide nanoparticles to intimately associate with microbial strains has been recognised due to their smaller size and higher surface to volume ratio. However, this ability is limited by the release of metal ions into solution. Sol-gel, surfactant-mediated, deposition-precipitation, anodization, wet-oxidation, microwave-assisted combustion, thermal evaporation template techniques, electrodeposition, and sonication are a few of the different ways that have been utilised to create nanoparticles. By using different techniques, metal oxide nanoparticles created by any of the aforementioned ways are employed to combat [1-9] bacterial strains. By using a variety of doping techniques, nanoparticles can have their catalytic activity and antibacterial characteristics improved. Scientists have long employed antimicrobial medications to prevent and eliminate bacteria and other germs, but over time, these microbes have acquired a certain type of resistance. Therefore, using nanoparticles was one of the most promising strategies to overcome this microbial resistance. It's interesting to note that various studies have found ZnO-NPs to be non-toxic to human cells. The fact that they are toxic to microorganisms and have good biocompatibility with human cells made their use as antibacterial agents necessary. High specific surface area-to-volume ratios of nanoparticles are primarily responsible for their diverse antibacterial mechanisms.In this study, we have created ZnO-SiO2/nanocomposites utilising the deposition-precipitation process, with tartaric acid serving as a stabilising agent and acetonitrile as the solvent. It was discovered that they had antifungal action against Candida parapsilosis and Aspergillus niger as well as antibacterial activity against gramme positive and gramme negative strains of Bacillus subtilis and E. Coli. This study's main goal was to look at how different strains of bacteria and fungi were affected by nanocomposite materials. While ZnO was employed to get rid of dangerous germs, SiO2 was used to boost photocatalytic activity.

Experimental

The deposition-precipitation approach was used to experimentally synthesise ZnO-SiO2 nanocomposite utilising acetonitrile as the solvent. Zinc nitrate Zn(NO3)2.6H2O (Merck), tartaric acid (Panreac), liquid ammonia (Biom), ethanol (Biom), silicon dioxide (DAEJUNG), and acetonitrile (PANREAC) are some of the substances utilised in experiments. bacterial resistanceBacillus subtilis and Escherichia coli were used as test microorganisms for the ZnO-SiO2 nanocomposite's antibacterial properties. Establishing a new bacterial cultureOxoid, UK: nutrient broth A glass bead-filled Erlenmeyer flask containing 100 mL was made. By adding buffer solution, the pH was brought down to 7.4, and the autoclave was run at 121°C for 15 minutes.

***Corresponding author:** Dr. Akhavan Clara, Departments of Neurosurgery, University of Medicine and Pharmacy, Iasi, Iran, E-mail: tlara@gmail.com

Received: 01-May-2023, Manuscript No: jhcpn-23-98147, **Editor assigned:** 03-May-2023, PreQC No: jhcpn-23-98147 (PQ), **Reviewed:** 17-May-2023, QC No: jhcpn-23-98147, **Revised:** 19-May-202,Manuscript No: jhcpn- 23-98147(R) **Published:** 27-May-2023, DOI: 10.4172/jhcpn.1000193

Citation: Clara A (2023) Mechanisms of Action of Antimicrobial Agents against Bacterial. J Health Care Prev, 6: 193.

Copyright: © 2023 Clara A. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Method of disc diffusion

Agar media was combined with distilled water to create nutrient agar. Agar medium and 10 mm paper discs used for wicks were autoclave sterilised before cooling in laminar air flow. A 50 mL fresh bacterial culture was used to inoculate the agar medium. Sterilised discs were then poured with synthesised nanocomposite and spread out in petri plates with a positive control in the middle. The petri dishes for 24 hours at 37 °C. Zone readers were used to measure the zones. A test was conducted using both bacterial strains. anti-fungal propertiesWith a small adjustment, the antifungal activity was carried out in accordance with Devi [10]. The agar well diffusion experiment was used to assess the antifungal activity of the synthesised ZnO-SiO2 nanocomposite in acetonitrile solvent. At 4 degrees Celsius, Sabouraud Dextrose Agar (SDA) slants were prepared and kept as stock cultures of Candida parapsilosis and Aspergillus niger. Nystatin was used as a positive control medication in parallel. We looked for signs of the zone of inhibition, which is the region around the walls, on the plates. Using a metre ruler, the diameter of these zones of inhibition was determined. The trials were carried out in triplicates, and the mean value was computed.

Results and Discussion

FT-IR stands for Fourier Transform Infrared Spectroscopy. The ZnO-SiO2 nanocomposite's FT-IR spectrum is displayed in (Figure 1). The stretching and bending vibrations of the OH group in the H2O molecule are responsible for the broad absorption band at 3000–3600 cm-1 and the peak at 1591 cm-1, respectively. 0.1 M ZnO-SiO2 Nano composite FT-IR spectrums. TGA, or thermogravimetric analysisFor the ZnO-SiO2 nanocomposite illustrated in Figure 1, the TGA-DSC curve depicts weight loss of the sample as a function of temperature. The four significant weight decreases were very visible. At 100 °C, there is a 6% weight loss in the first stage as a result of the elimination of physically adsorbed water molecules. The elimination of carbon monoxide from tartaric acid at 300°C is shown by the second curve, which shows a weight loss of 9%. The third significant weight drop of 12% was caused by the removal of two water molecules, which clarified how zinc tartrate was converted into ZnO. The temperature above which the vicinal hydroxyl group of silica were entirely condensed was revealed by weight loss at 700°C.

DLS, or dynamic light scattering

An important tool for determining the size of nanoparticles in solution is dynamic light scattering (DLS). By examining the modulation of the scattered light intensity as a function of time, DLS analyses the light scattered from a laser that passes through a colloidal solution in order to estimate the hydrodynamic size of the particles and particle cumulation.

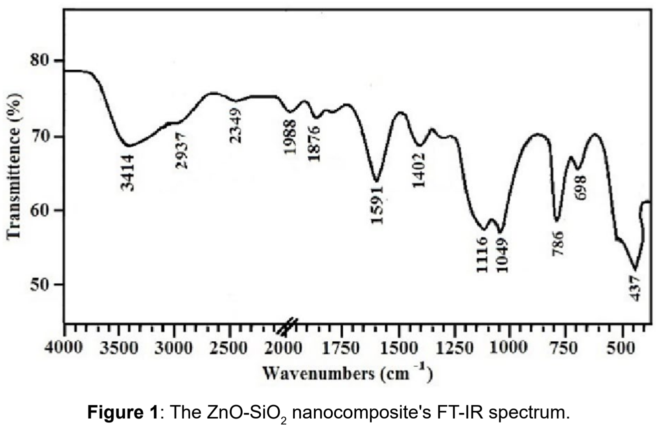

Figure 1: The ZnO-SiO_2 nanocomposite's FT-IR spectrum.

Conclusion

The goal of the current study was to use the deposition precipitation method to create a ZnO-SiO2 nanocomposite in an acetonitrile solvent. In order to confirm the size and shape of the produced nanocomposite, various characterizations were done. ZnO-SiO2 nanocomposite shown superior antibacterial activity against Bacillus subtilis when compared to E. coli and superior antifungal activity when compared to Candida parapsilosis when compared to Aspergilus niger. The antibacterial activity of methanol solvent was higher than the antifungal activity.

Acknowledgement

The authors would like to express their gratitude to the Higher Education Commission of Islamabad for providing the funding necessary to carry out this research.

References

1. Doherty R, Madigan S, Warrington G, Ellis J (2019) Sleep and nutrition interactions: implications for athletes. Nutrients 11:822.
2. Jagannath A, Taylor L, Wakaf Z, Vasudevan SR, Foster RG, et al. (2017) The genetics of circadian rhythms, sleep and health. Hum Mol Genet 26:128-138.
3. Somberg J (2009) Health Care Reform. Am J Ther 16: 281-282.
4. Wahner-Roedler DL, Knuth P, Juchems RH (1997) The German health-care system. Mayo Clin Proc 72: 1061-1068.
5. Nally MC (2009) Healing health care. J Clin Invest 119: 1-10.
6. Weinstein JN (2016) An “industrial revolution” in health care: the data tell us the time has come. Spine 41: 1-2.
7. Marshall EC (1989) Assurance of quality vision care in alternative health care delivery systems. J Am Optom Assoc 60: 827-831.
8. Cutler (2021) Building health care better means reining in costs. In JAMA Health Forum 2: 210117-210117.
9. Lindeque BG (2009) American Health Care System Disaster. Orthopedics 32: 551.
10. Ampomah IG, Malau-Aduli BS, Malau-Aduli AE, Emeto TI (2020) Effectiveness of integrated health systems in Africa: a systematic review. Medicina 56: 271.