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SYNTHESIS CHARACTERIZATION AND ANTIMICROBIAL ACTIVITY OF TITANIUM NANOPARTICLES

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ABSTRACT

Nanotechnology is becoming a new area of increasing research and industrial interest since the 1980. Nanochemistry or Nanotechnology are related with the production and the reactions of Nanoparticles and their compounds. The present study included the chemical reduction of titanium ions through trisodium citrate and testing for their antimicrobial activity. The scope of the present study is to synthesize titanium Nanoparticles and evaluate its antibacterial activity. The present study to investigate synthesize titanium Nanoparticles and characterization of synthesized titanium Nanoparticles confirmed by UV-visible spectrophotometer, FTIR analysis and SEM analysis and also to analysis the antimicrobial activity of titanium Nanoparticles.

KEYWORD: Antimicrobial, FTIR, Nanoparticals, SEM, UV-spectrometer.

1. INTRODUCTION

Nanoscience has been established recently as a new interdisciplinary science. It can be defined as a whole knowledge on fundamental properties of nano-size objects. The prefix “nano” indicates one billionth or 10-9 units. The nature of this unit being determined by the word that follows. It is widely accepted in the context of nanoscience and nanotechnologies, the units should only be those of dimensions, rather than of any other unit of scientific measurement. It is widely agreed that nanoparticles are clusters of atoms in the size range of 1–100 nm. At present time nanochemistry becomes one of the main growing directions of nanoscience. Metallic nanoparticles exhibit size and shape-dependent properties that are of

interest for applications ranging from catalysts and sensing to optics, antibacterial activity and data storage. For instance, the antibacterial activity of different metal nanoparticles such as titanium colloids is closely related to their size; that is, the smaller the titanium nuclei, the higher the antibacterial activity. The most common approach for synthesis of titanium nanoparticles is chemical reduction by organic and inorganic reducing agents.

2. SCOPE AND OBJECTIVES

The scope of the present study is to synthesize titanium Nanoparticles and evaluate its antibacterial activity. The objectives of the present study to investigate synthesize of titanium Nanoparticles and to characterization of synthesized titanium Nanoparticles confirmed by UV-visible spectrophotometer, FTIR analysis and SEM analysis.

3. MATERIALS AND METHODS

3.1 Experimental

Titaniumdioxide (TiO_2) and Tri sodium citrate ($Na_3C_6H_5O_7$) have been used in the synthesis of titanium nanoparticles. To synthesize different-sized TiNPs, the spherical TiNPs were prepared according to the literature procedure by Fang et al.(2005), by reducing aqueous TiO_2 with sodium citrate at boiling temperature. In typical procdure, 50ml of 0.001 M TiO_2 was heated to boiling. To this solution, 5ml of 1% trisodium citrate was added drop by drop. The solution was heated at boiling point under continuous stirring. The reaction was allowed to take place until the color changed to a yellow solution. The solution was then cooled to room temperature. The TiNPs in this solution were called citrate-TiNPs.

3.2 UV-Visible spectra analysis

The reduction of pure titanium ions was monitored by measuring the UV-Visible spectrum of the reaction medium and the absorption spectra were recorded over the range of 300-700 nm using UV-Vis spectrophotometer.

3.3 Fourier transform infrared spectroscopy

To determine fourier transform infra-red (FTIR) pattern of the TiO_2 nanoparticles was freeze-dried and the dried powder was diluted with potassium bromide in the ratio of 1:100 and recorded the spectrum in perkin elmer FTIR spectrum.

3.4 SEM analysis of titanium nanoparticles

The scanning electron microscopy (SEM) analysis of freeze dried sample was performed by mounting nanoparticles on specimen stubs with double-sided adhesive tape and coated with platinum in a sputter coater and examined under JEOL 63861 SEM (Japan) at 10 Kv.

3.5 Preparation of medium

Suspend 2.8 grams nutrient agar in 100ml distilled water. Heat to boiling and dissolve the medium completely. Sterilize by autoclaving at 15 Ibs pressure (121^0c) for 15minutes. Mixed well and poured into the sterile petri plates. Bacteria as escherichia coli and staphylococcus aureus were used and they were obtained from the microbiology laboratory of bose laboratory, madurai.

4. RESULTS AND DISCUSSION

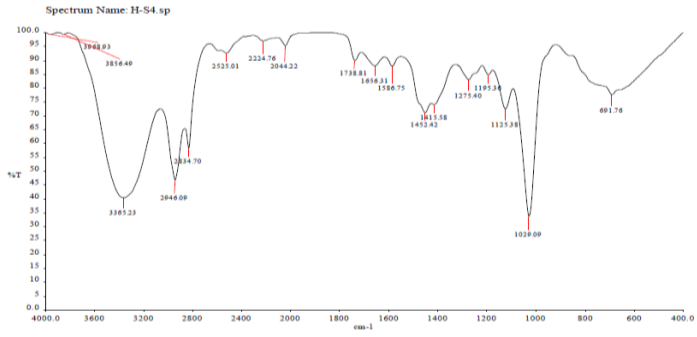
The synthesis of titanium dioxide nanoparticles through trisodium citrate were carried out. Titanium is used as reducing agent as titanium dioxide has distinctive properties such eco-friendly nanoparticles in bactericidal, wound healing and other medical and electronic application, makes this method potentially exciting for the large-scale synthesis of other inorganic materials (nanomaterials). Titanium dioxide and trisodium citrate were used as starting material for the preparation of titanium nanoparticles. The titanium colloid was prepared by using chemical reduction method.

4.1 ULTRAVIOLET/VISIBLE (UV/VIS) SPECTROSCOPY

The absorption band in the 350 nm to 450nm region is typical for the titanium nanoparticles. With increasing particles size, the Plasmon absorption shifts toward red.

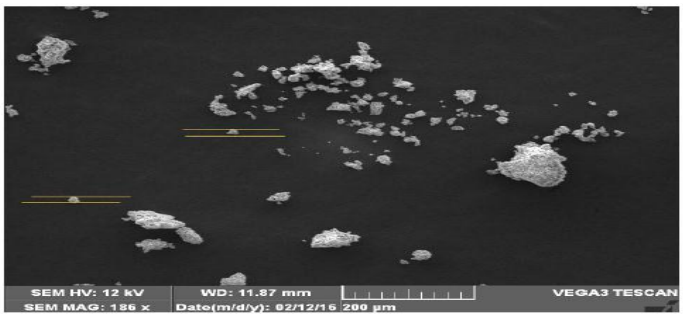
4.2 FOUEIER TRANSFORM INFRARED SPECTROSCOPY (FTIR) ANALYSIS

The band of carboxyl or carbonyl group at 1660 to 1500 and 1390 to 1260 cm^{-1} region. This may be the reason for the reduction of the transmittance at this region in the case of spectrum of nanoparticles. The shift of the band from 1656 to 1586 indicates the formation of metal carbonyl groups. It is due to the stabilization of Ti nanoparticles by the -COO- group of trisodium citrate. This asymmetric shift can be comparable with the data presented by previous works.



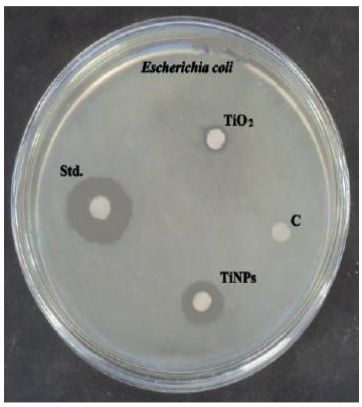
4.3 SEM ANALYSIS

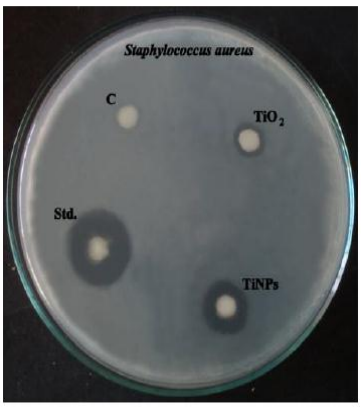
SEM analysis was carried out to understand the topology and the size of the Ti-NPs, which showed the synthesis of higher density polydispersed spherical Ti-NPs of various sizes. The SEM analysis showed the particle size 84.90 nm as well the spherical structure of the nanoparticles.



4.4 ANTIMICROBIAL ACTIVITY TABLE

Microorganism	Titanium Dioxide (30µl)	Titanium Nano Particles (30µl)	Std (Chloromphenical) (30µl)	Con (30µl)
Escherichia Coli (Mm)	8	10	18	0
Staphylococcus Auerus (Mm)	7	10	19	0





5. CONCLUSION

The following conclusion obtained from the study The aqueous titanium ions exposed to the trisodium citrate results in the synthesis of titanium nanoparticles, it was confirmed by the formation of brown colour. Synthesized titanium nanoparticles further confirmed in UV Visible spectrum and FTIR. These synthesized titanium nanoparticles were further confirmed by using SEM. The SEM analysis showed the particle size between 84.90nm as well the spherical structure of the nanoparticles. Proven antibacterial activity against different microorganisms such as E. coli and S. aureus established. It is confirmed the titanium nanoparticals are capable of rendering high antibacterial efficacy and hence has a great potential in the preparation of drugs used against bacterial diseases. Application of Ti nanoparticles based on these findings may lead to valuable discoveries in various fields such as medical devices and antimicrobial systems. The present study exhibit a simple method of synthesis of titanium nanoparticles from a novel primitive chemical source. This method can be further used for industrial production of nanoparticles at room temperature and with a of newer and more potent antimicrobial agents.

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