European Journal of Molecular & Clinical Medicine

ISSN 2515-8260 Volume 07, Issue 11, 2020

Characterization of Silver-Titanium Nanoparticles UsingUV-Visible Spectrophotometer and Scanning Electron Microscopy (SEM)Analysis

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ABSTRACT

The current study deals with the characterization of silver-titanium nanoparticles (Ag-TiO_2 NPs) synthesized using ethanolicAloe veraleaves extract and aqueous Psidiumguajavaleaves extract (unpublished data) is observed using UV-Vis spectrophotometer, and SEM. The results revealed that the shape of synthesized silver and titanium dioxide nanoparticles is more or less spherical and average size ranges from 80 to 100 nm and 130 to 210 nm in SEM respectively.

INTRODUCTION

In recent years, the synthesis and characterization of nanomaterials (NMs) have become a very active area of research. Therefore, the application of these materials with special physicochemical properties is gaining more and more importance in different fields of research. Plant mediated synthesis of silver nanoparticles is gaining more importance owing its simplicity, rapid rate of synthesis of nanoparticles and ecofriendliness (Aarti, *etal*., 2014 and Bonnia*etal*., 2016). Silver nanoparticles (AgNPs) are important materials that have been studied extensivelyand have several important applications in the field of bio-labelling, sensors, antimicrobial agents and filters (Chaterjee and Islam. 2008,Seery,*etal*., 2007). Such nanoscale materials possess unique electrical, optical as well as biological properties and are thus applied in catalysis, biosensing, imaging, drug delivery, nanodevice fabrication and medicine (Bittmann, *etal*., 2012 and Sileikaite*etal*.,2006). Nanoparticles exist in a number of shapes depending upon the synthesis procedures.Nanostructures have attracted huge interest as a rapidly growing class of materials for many applications. Several techniques have been used to characterize the size, crystal structure, elemental composition and a variety of other physical properties of nanoparticles. In several cases, there are physical properties that can be evaluated by more than one technique (Inmaculada de la Calle, and Vanesa Romero-Rivas 2018, StefanosMourdikoudis, *etal.*,2018).Thus, these results are very encouraging and indicate that this should be studied more extensively with X-ray diffraction (XRD) and Fourier Transform Infrared Analysis (FTIR).

MATERIALS AND METHODS

To confirm the synthesis of silver-titanium nanoparticles the following methods are essential. The following characteristic methods were used to characterize the nanoparticles that were synthesizedbiologically.

UV-Visible SpectrophotometerAnalysis

For silver nanoparticles, after colour change from pale yellow to reddish brown, it is analysed in

UV-Visible spectrophotometer to confirm the formation of silver nanoparticles. The absorbance reading from 200-700 nm was taken using the spectrophotometer. The same step was followed for titanium dioxide nanoparticles, when a colour change to light green is observed. The absorbance reading from 200 to 1000 nm wastaken (AntarikhSaxena, *etal.*,2018, Troiani*etal.*,2003)

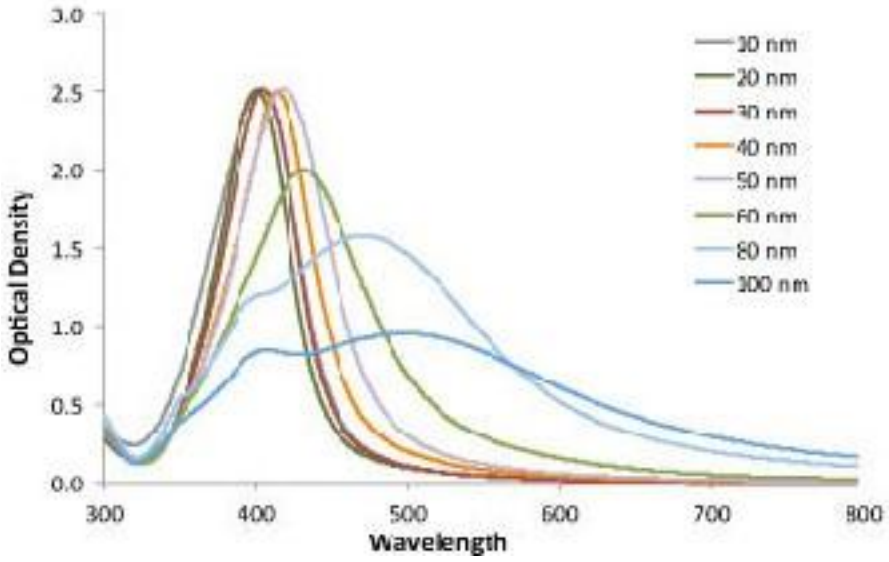
Scanning ElectronMicroscopy

Scanning Electron Microscopy (SEM) offer nanometer resolution for measuring nanoparticle size. We used this technique to measure the size of silver and titanium dioxide nanoparticles. The plant extract sample biomass after reaction spontaneously precipitates at the bottom of the tubes. After the precipitation, the suspension above the precipitate was sampled for SEM observation. SEM samples of ethanolic suspension both of silver and titanium dioxide nanoparticles were fabricated by dropping the suspension onto clean electric Stubs and allowing water to completelyevaporate.

RESULTS

UV-Visible SpectrophotometerAnalysis

The UV-Visible spectrophotometer was used to study the formation of AgNPsandTiO2NPs.ThespectralanalysiswasperformedusingELICOSL159.TheUV- Visible analysis was done in range between 200 to 700 nm for silver nanoparticles biosynthesis and 200 to 1000 nm for titanium dioxide nanoparticles. Metallic nanoparticles would show distinct absorption spectrum when suspended in aqueous suspension. Theoretically, colloidal silver nanoparticles possess optical spectrum with absorption peak, also known as the surface Plasmon resonance (SPR) lies in the range 400-460 nm(Bonnia*etal*., 2016). This analysis was used to detect the optimization conditions for the biosynthesis of silver and titanium dioxidenanoparticles.



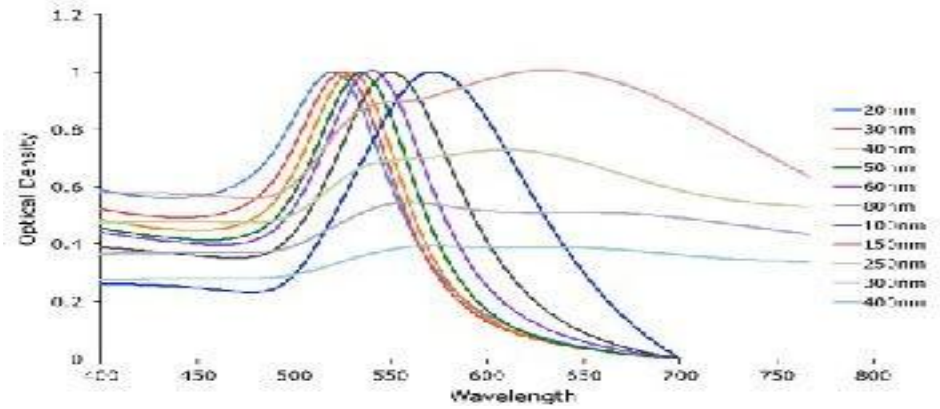
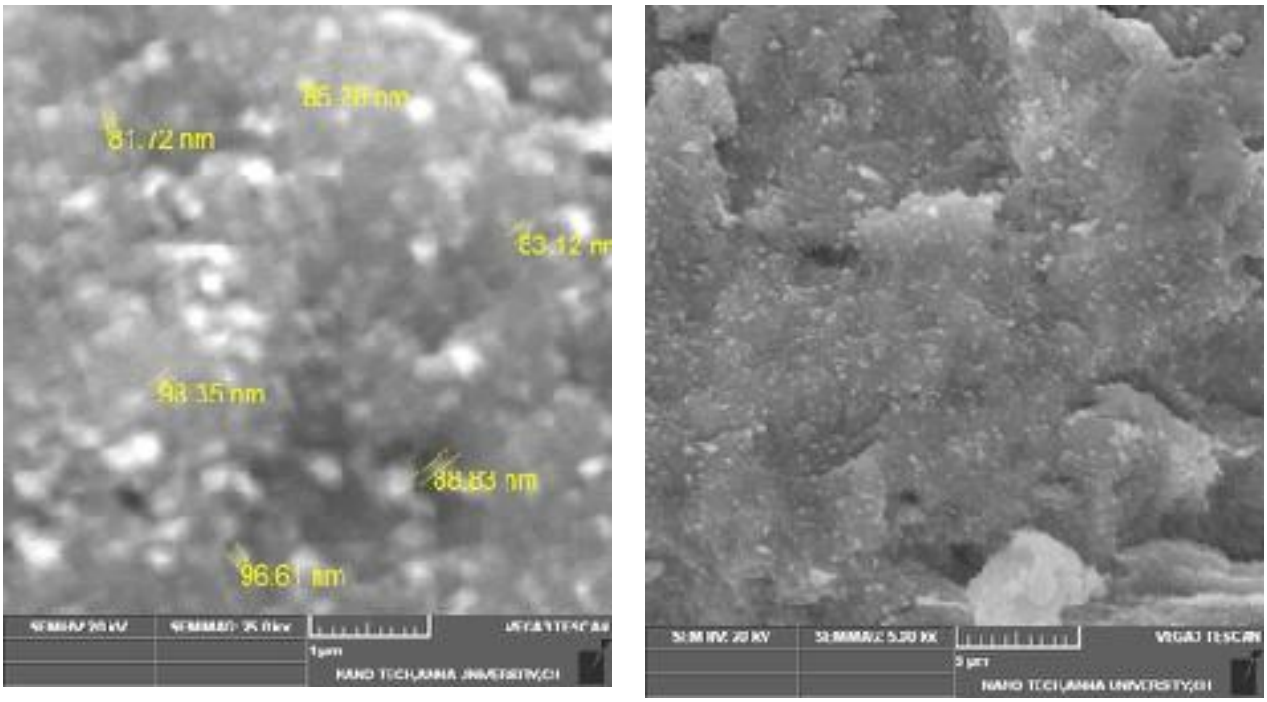


Figure 1:UV-Visible spectrophotometric analysis of silver and titanium dioxide nanoparticles.

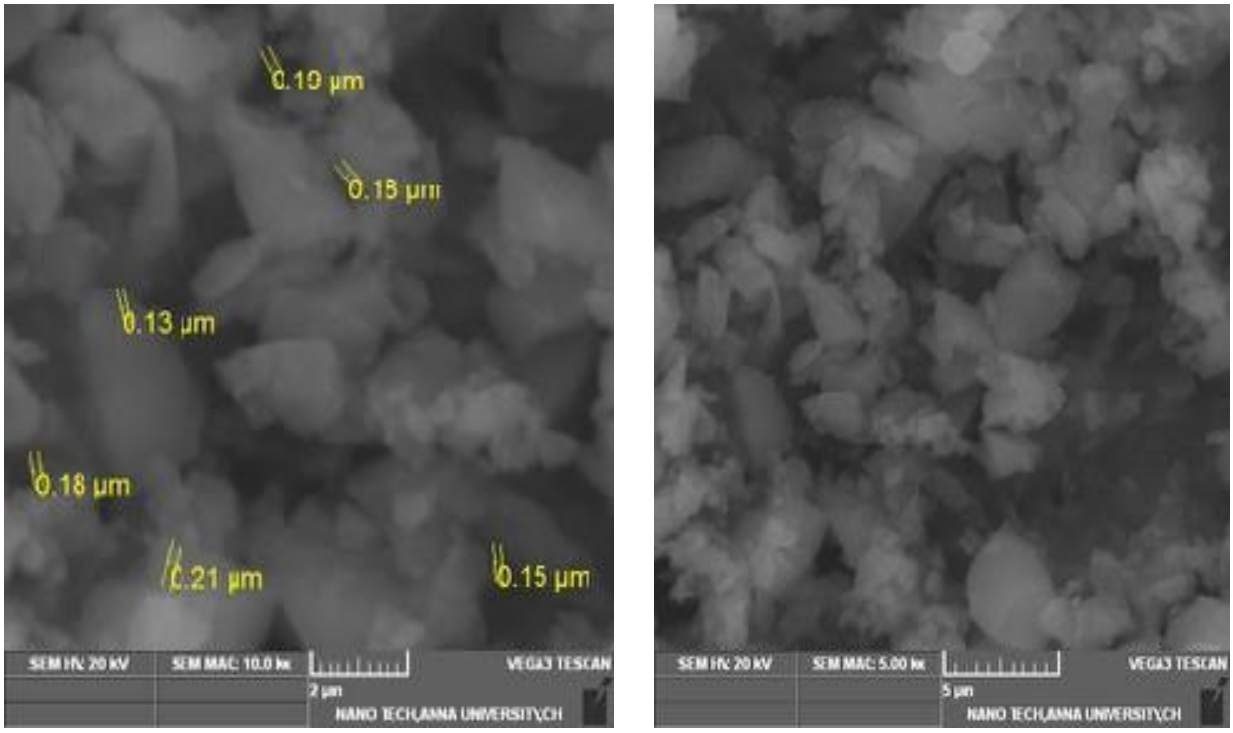
Scanning Electron Microscopy (SEM)ANALYSIS

The synthesised silver and titanium dioxide nanoparticles were analysed using Scanning Electron Microscopy (SEM) following the gold sputtering technique. The given figures show the SEM image of silver nanoparticles using *Aloe vera*leaves extract and titanium dioxide nanoparticles using *Psidiumguajava*leaves extract. It was observed that the silver nanoparticle size ranges between 80 nm to 100 nm and titanium dioxide nanoparticles size ranges from 130 nm to 200 nm, confirming a non toxic synthesis of nanoparticles.



(a) (b)

Figure 2:SEM micrograph of silver nanoparticle synthesised from *Aloe vera* extract (a) 25 kxmagnification(b)5 kxmagnification.



(a) (b)

Figure 3:SEM micrograph of titanium dioxide nanoparticles synthesized *Psidiumguajava*leaves extract (a) 10 kxmagnification(b)5 kxmagnification

CONCLUSION

The characterization was carried out using UV-Visible spectrophotometer, and Scanning Electron Microscopy (SEM). The UV-Visible spectrophotometer analysis was used to detect the optimization conditions for the biosynthesis of silver and titanium dioxidenanoparticles.The biosynthesized silver and titanium dioxide nanoparticles were more or less spherical in shape and their crystal size ranges from 80 to 100 nm and 130 to 200 nm, respectively confirming a non-toxic synthesis of nanoparticles through SEM analysis.

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