The Pharma Innovation Journal 2022; SP-11(7): 266-269

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; SP-11(7): 266-269

www.thepharmajournal.com
Received: 19-04-2022
Accepted: 21-06-2022

Vasanth V
Research Scholar, Department of Sericulture, Forest College and Research Institute, Tamil Nadu Agricultural University, Mettupalayam, Tamil Nadu, India

Murugesh KA
Associate Professor, Department of Sericulture, Forest College and Research Institute, Tamil Nadu Agricultural University, Mettupalayam, Tamil Nadu, India

Susikaran S
Assistant Professor, Department of Sericulture, Forest College and Research Institute, Tamil Nadu Agricultural University, Mettupalayam, Tamil Nadu, India

Corresponding Author
Vasanth V
Research Scholar, Department of Sericulture, Forest College and Research Institute, Tamil Nadu Agricultural University, Mettupalayam, Tamil Nadu, India

Synthesis of titanium dioxide nanoparticles using *Spirulina platensis* algae extract

Vasanth V, Murugesh KA and Susikaran S

DOI: https://doi.org/10.22271/tpi.2022.v11.i7Sd.13643

Abstract
An investigation of green synthesis of titanium dioxide nanoparticles using *Spirulina platensis* algae extract was undertaken in the Department of Sericulture, Forest College and Research Institute, Mettupalayam. The nanoparticles formation, particle size, exterior morphology and shape of synthesized TiO_2 NPs were analyzed through UV-Vis absorbance spectroscopy, X-Ray diffraction and Scanning electron microscope (SEM) respectively. The results showed that the absorbance spectra of synthesized NPs were observed at 300nm. X-Ray diffraction analysis revealed that the formation of good crystalline TiO_2 NPs with anatase phase. The synthesised NPs were in spherical shape and dispersed irregularly. The green synthesised of TiO_2 NPs is a simple approach, inexpensive and eco-friendly process which having potential applications in various fields.

Keywords: TiO_2 NPs, green synthesis, *S. platensis*, characterization

Introduction

The nanomaterials are receiving considerable attention because of their exceptional physicochemically properties over bulk counterparts. Nanotechnology is a field of science with enormous potential in medicine. Nanotechnology plays an extremely significant role in present research as it is the most proficient technology that can be used in almost all the fields such as cosmetics, pharmaceuticals, environmental health, food and feed, chemical industry, agricultural science, energy sector, drug and gene delivery, mechanics and space industry. The synthesis of nanomaterials using chemical methods is very expensive, requires complex steps and leads to the absorption of toxic chemicals on the surface that may have an adverse effect on the agricultural application and are hazardous to the environment. Therefore, the development of clean, biocompatibility, non-toxic and eco-friendly methods using microorganisms, enzymes and plant extract is gaining importance in nanotechnology.

Titanium dioxide nanoparticles are natural mineral oxide widely used in pharmaceuticals, cosmetics, food colouring and implantable biomaterials because of their physicochemical properties such as photocatalyst, antimicrobial agent and preservatives (Gao *et al.*, 2003) [1]. Synthesis of nanoparticles under eco-sustainable, nontoxic green conditions is of greater importance to combat the rising concerns about the toxicity of metallic nanomaterials in medical and technological applications. Plant extracts may act both as reducing agents in the synthesis of nanoparticles. The source of plant extract is known to have an impact on the characteristics of nanoparticles (Kumar and Yadav, 2009) [2]. Among various semiconductor nanoparticles, titanium dioxide (TiO_2) nanomaterial has been broadly recognised as semiconductors as they are a more ideal component for environment and energy applications because of their identical properties (Mohamed, 2012) [3].

Green synthesis of nanoparticles from plant extracts and microbes has attracted the attention of researchers in recent years. Biosynthesis of nanoparticles is considered better than chemical synthesis because of the formation of toxic chemical species which are adsorbed on the particle surface after chemical synthesis. Moreover, they are cost-effective and environmental friendly in nature due to a biological process, which makes them superior to chemical and physical synthesis (Parashar *et al*., 2009) [4].

The blue-green algae *Spirulina platensis* contains various minerals and 18 amino acids such as glycine, glutamine, histidine, lysine, methionine, cysteine, creatine, phenylalanine, serine, proline, tryptophan, asparagine, pyruvic acid, and pivotal vitamins like tocopherol, biotin, thiamine, niacin, riboflavin, proterozoic acid, folic acids, beta-carotene and vitamin B12, etc.

(Soliman and Mohamed, 2021). In this study, we have synthesized TiO_2 NPs exploiting aqueous extract of *S. platensis* a green reducing material and stabilising agent. These biogenically synthesized TiO_2 NPs were characterized using UV-Vis spectroscopy, XRD and Scanning electron microscopy (SEM).

Materials and Methods

Algae

The dried powder of Spirulina was collected from R.K. Algae Centre in Mandapam, Tamil Nadu, India. The confirmation of algal species was done at Botanical Survey of India, Coimbatore, Tamil Nadu.

Preparation of aqueous extraction of *S. platensis*

The aqueous extract of *S. platensis* was obtained by heating 10g of finely ground powder in 100 ml of deionized water at 90 °C for 45 mins, then the solution was filtered through Whatman filter paper No.1 to remove the debris. The resultant clear green coloured solution obtained was stored at 4-8°C for further study (Roy *et al*., 2019) [13].

Synthesis of titanium dioxide nanoparticles

Spirulina mediated TiO_2 NPs were synthesised utilising 0.01 mM titanium dioxide and aqueous extract of *Spirulina platensis* as bio-reductant and capping agent in green synthesis. Aqueous extract of 20 mL was added to 80 mL of 0.01 M TiO_2 solution, which was maintained at room temperature for 6 hours with continuous stirring in a hotplate magnetic stirrer. A colour change confirmed the production of TiO_2 NPs (pale yellow).

UV-Vis spectroscopy, XRD and SEM were used to describe the green synthesis of *Spirulina*-mediated TiO_2 NPs.

UV-Vis Absorbance Spectroscopy

The green synthesis of *Spirulina* mediated titanium dioxide nanoparticles were confirmed by optical measurement using UV-visible spectroscopy in the wavelength ranging between 200 and 800 nm at the resolution of 1 nm (Subhapriya *et al*., 2018) [12].

X-Ray Diffraction

The phase development and crystallinity of *Spirulina* induced TiO_2 NPs were studied using X-Ray Diffraction, an analytical technique. Smart Lab was used to record the XRD pattern of produced *Spirulina*-mediated TiO_2 NPs and Powder X software was used to compute the lattice parameters. The Scherrer's equation was used to compute the particle size (d spacing value) of the sample (Sun *et al*., 2000) [5].

Scanning Electron Microscope

The size and shape of nanoparticles was measured with nanoscale precision using a scanning electron microscope (SEM) (Yedurkar *et al*., 2016) [6].

Results and Discussion

UV-Vis Absorbance Spectroscopy

The molecule size and band hole of integrated green synthesis of titanium dioxide nanoparticles were determined using UV–vis absorbance spectroscopy Fig. 1 displays the UV absorption spectra of produced TiO_2, which showed a prominent absorption band at 300 nm. The present finding can be correlated with Swathi *et al.* (2019) [14] who reported that spectral image displays the absorption peaks at 350 nm for green synthesis of TiO_2 nanoparticles and Ahamad *et al.* (2022) indicated the presence of a titanium dioxide band at 380–400 nm. Similarly, Rathna *et al.* (2020) revealed the good crystalline nature of green route mediated AgNPs showing a peak at 420 nm indicating the formation of nanoparticles.

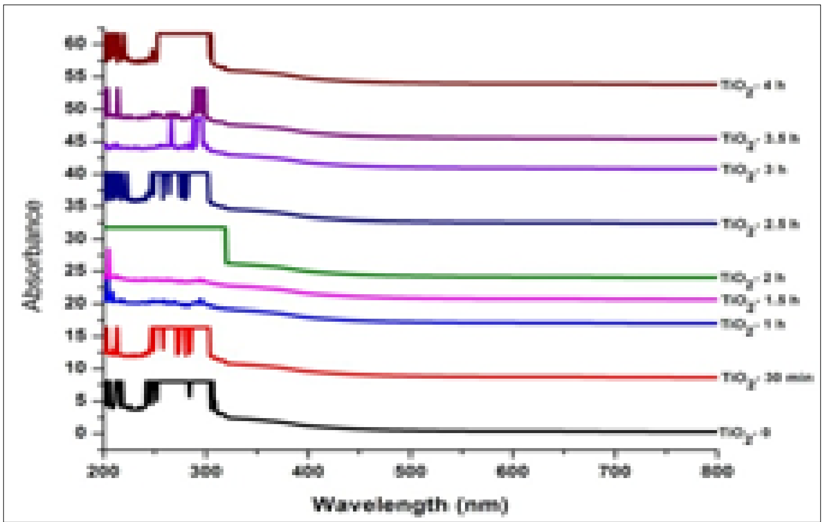

Fig 1: UV-Vis absorption spectra of TiO_2 NPs synthesised using *S. platensis* extract

X- Ray Diffraction analysis

The XRD pattern of green synthesised of TiO_2 nanoparticles is shown in Fig. 2. With diffraction angles of 27.79, 36.45, 41.57, 44.41, 54.65, 57.01, 63.11, 64.39, 69.22, 70.09, 76.88, 82.61, 84.47, and 88.01, it indicates the formation of good crystalline titanium dioxide with anatase phase shape. The prominent peak at 27.79 in the XRD pattern of green synthesised TiO_2 nanoparticles is only connected with the crystallographic plane of TiO_2 anatase. The final material's stoichiometry is highly dependent on the partial pressure used during the synthesis. As a result, the synthesised TiO_2 nanoparticles could exhibit a variety of stoichiometries. The peaks of graph are in good agreement with the literature report (Akarsu *et al.*, 2006) [8]. The location of peaks was compared to literature values and the presence of titanium dioxide particles was confirmed. The average size of the particles was calculated using Debye-Scherrer"s formula.

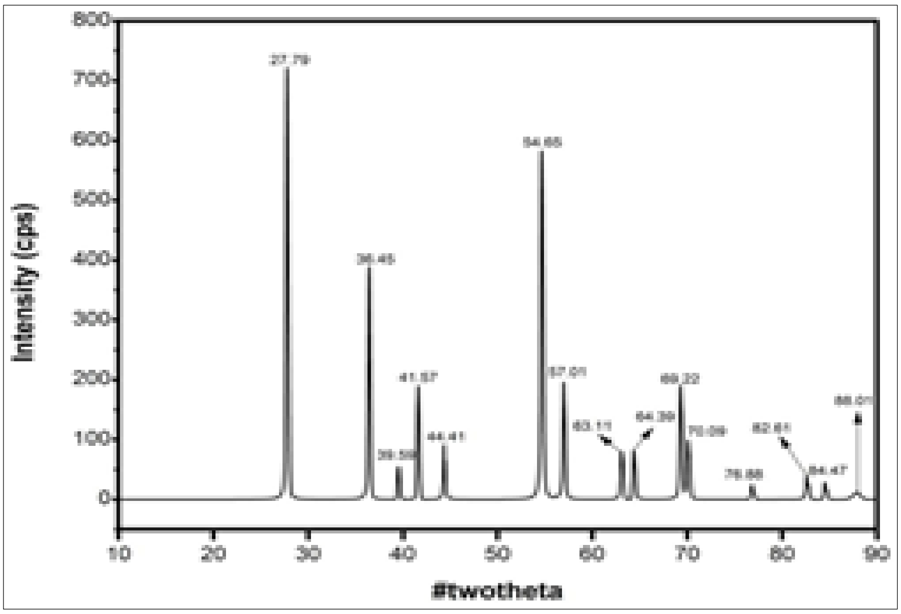

Fig 2: XRD pattern of biosynthesised TiO_2 NPs using *Spirulina platensis* extract

Scanning Electron Microscope

Scanning electronic microscopy was used to investigate the form, size, and surface features such as morphology. Fig 3 & 3a. clearly showed an SEM images of synthesised TiO2 nanoparticles made with *S. platensis* aqueous extract which are irregularly dispersed and spherical in shape. The average size of the produced nanoparticles using SEM images were found to be in the range of 90 to 150 nm. Fig 3 denotes a 5μm scale range, while fig.3a denotes a 4μm scale range. Similarly green synthesised metal nanoparticles loaded ultrasonic-assisted *S. platensis* algal extract showed rougher and irregular spores developed on the surface of UASP and confirmed that the metal nanoparticles (Ag, Cr, Pb and Zn) were successfully coated on UASP material (Gunasundari *et al.*, 2017) [9]. In line with this result of Santhosh Kumar *et al.* (2014) [10] revealed that SEM images of *Psidium guajava* mediated TiO_2 NPs were smooth and sphericalin shape with various physical morphology, particle size and aspect ratio.

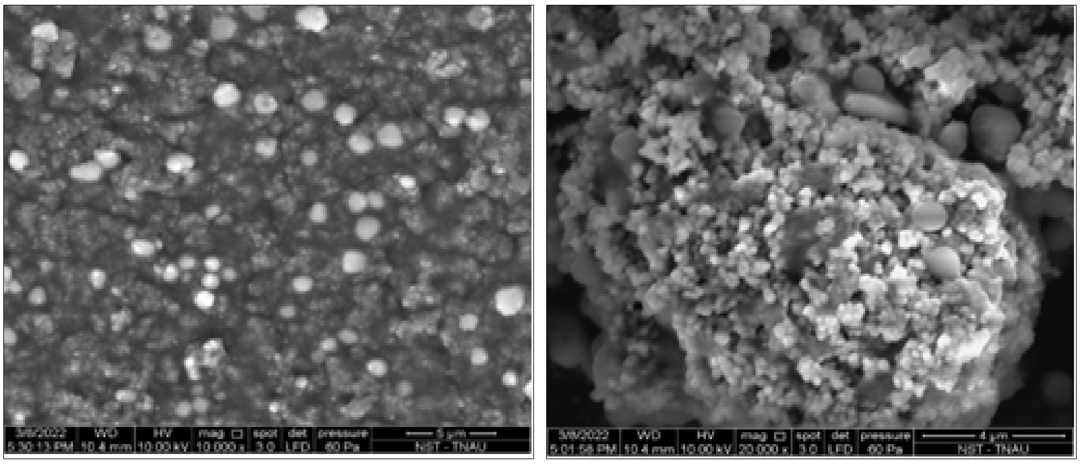

Fig 3: SEM image of synthesised TiO_2 NPs from *S. platensis* extract

Conclusion

The TiO_2 nanoparticles were successfully synthesised with *S. platensis* aqueous extract. The synthesised TiO_2 NPs were investigated by UV-Vis, XRD and SEM which indicated the properties of TiO_2 NPs. The UV-Vis spectral result showed that nanoparticles synthesised properly, XRD result predicte that the particles were crystalline, the Sem result displayed that the sample was nearly spherical in shape. The synthesis of NPs using green approach is simple, inexpensive and eco-friendly process, which reduces the use of toxic chemicals.

References

1. Gao R, Safrany A, Rabani J. Reactions of TiO2 excess electron in nanocrystallite aqueous solutions studied in pulse and gamma-radiolytic systems. Radiation Physics and Chemistry. 2003 May 1;67(1):25-39.
2. Kumar V, Yadav SK. Plant-mediated synthesis of silver and gold nanoparticles and their applications. Journal of Chemical Technology & Biotechnology: International Research in Process, Environmental & Clean Technology. 2009 Feb;84(2):151-7.
3. Mohamed RM. UV-assisted photocatalytic synthesis of TiO2-reduced graphene oxide with enhanced photocatalytic activity in decomposition of sarin in gas phase. Desalination and Water Treatment. 2012 Dec 1;50(1-3):147-56.
4. Parashar V, Parashar R, Sharma B, Pandey AC. Parthenium leaf extract mediated synthesis of silver

nanoparticles: a novel approach towards weed utilization. Digest Journal of Nanomaterials & Biostructures (DJNB), 2009 Mar 1, 4(1).
5. Sun S, Murray CB, Weller D, Folks L, Moser A. Monodisperse FePt nanoparticles and ferromagnetic FePt nanocrystal superlattices. Science. 2000 Mar 17;287(5460):1989-92.
6. Yedurkar S, Maurya C, Mahanwar P. Biosynthesis of zinc oxide nanoparticles using *Ixora coccinea* leaf extract: A green approach. Open Journal of Synthesis Theory and Applications. 2016 Jan 3;5(1):1-4.
7. Kumarasamy R, Navyaka P, Haque E. Bioengineered Silver Nanoparticle from Spirulina platensis in attenuating biofilm mediated virulence in Vibrio parahemolyticus: An *in vitro* and *in vivo* Approach. International Journal of Pharmaceutical Investigation. 2020 Dec 10;10(4):486-91.
8. Akarasu M, Sayılkan F, Erdemoğlu S, Akarsu M, Sayılkan H, Erdemoğlu M, *et al*. Characterization of the hydrothermally synthesized nano-TiO2 crystallite and the photocatalytic degradation of Rhodamine B. Journal of hazardous materials. 2006 Feb 28;129(1-3):164-70.
9. Gunasundari E, Senthil Kumar P, Christopher FC, Arumugam T, Saravanan A. Green synthesis of metal nanoparticles loaded ultrasonic-assisted spirulina platensis using algal extract and their antimicrobial activity. IET Nanobiotechnology. 2017 Sep;11(6):754-8.
10. Santhoshkumar T, Rahuman AA, Jayaseelan C, Rajakumar G, Marimuthu S, Kirthi AV, *et al*. Green synthesis of titanium dioxide nanoparticles using Psidium guajava extract and its antibacterial and antioxidant properties. Asian Pacific journal of tropical medicine. 2014 Dec 1;7(12):968-76.
11. Ahmad W, Jaiswal KK, Soni S. Green synthesis of titanium dioxide (TiO2) nanoparticles by using Mentha arvensis leaves extract and its antimicrobial properties. Inorganic and Nano-Metal Chemistry. 2020 Oct 2;50(10):1032-8.
12. Subhapriya S, Gomathipriya P. Green synthesis of titanium dioxide (TiO2) nanoparticles by Trigonella foenum-graecum extract and its antimicrobial properties. Microbial pathogenesis. 2018 Mar 1;116:215-20.
13. Roy A, Bulut O, Some S, Mandal AK, Yilmaz MD. Green synthesis of silver nanoparticles: biomolecule-nanoparticle organizations targeting antimicrobial activity. RSC advances. 2019;9(5):2673-702.
14. Swathi N, Sandhiya D, Rajeshkumar S, Lakshmi T. Green synthesis of titanium dioxide nanoparticles using Cassia fistula and its antibacterial activity. Int. J Res. Pharm. Sci. 2019;10(2):856-60.