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ANTIDIABETIC AND ANTIBACTERIAL ACTIVITY OF BIOSYNTHESIZED TITANIUM DIOXIDE NANOPARTICLES

G. JAYALAKSHMI [a*], DHANALEHA [a] AND S. JAYAPRADHA [a]

[a] Department of Microbiology, Sri Lakshmi Narayana Institute of Medical Sciences affiliated to Bharath Institute of Higher Education and Research, Chennai, Tamilnadu, India.

AUTHORS' CONTRIBUTIONS

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Because of their effectiveness in scattering visible light and imparting whiteness, brightness, and high opacity, titanium dioxide nanoparticles are extensively used in plastic compositions. In addition, titanium dioxide's ability to absorb UV light radiation can considerably improve the weather ability and durability of polymer items. When chalking stability and color preservation are desired, titanium dioxide nanoparticles have been used in applications such as PVC window profiles and agricultural films. Commercially available titanium dioxide is rarely pure. Multilayer inorganic structures and, in some cases, organic treatments are applied to the surfaces of Titanium dioxide nanoparticles to improve compatibility and dispensability. Titanium dioxide is quite vital these days, especially for diabetics. As a result, we prepared for antibacterial action with titanium dioxide and the bacterium *Saccharomyces cerevisiae*. Titanium dioxide was pulverized and tested after being centrifuged at 2000 rpm for 10 minutes and incubated for 24 hours.

Keywords: Nanoparticles; spectroscopy; antidiabetic, titanium dioxide, *Saccharomyces cerevisiae.*

1. INTRODUCTION

Nanoscience and nanotechnology are the study and use of extremely small objects, and they may be applied in chemistry, biology, physics, materials science, and engineering, among other subjects. In fact, using the microscopes often used in high school science classrooms, it's hard to observe. The microscopes needed to see things at the nanoscale were invented relatively recently—about 30 years ago [1]. Nano particles (NPs; 1–100 nm in size) have a special place in nanoscience and nanotechnology, not only because of their particular properties resulting from their reduced dimensions, but also because they are promising building blocks for more complex nanostructures. NPs hold a unique place in nanoscience and nanotechnology, not only because of their unique features arising due to their small size,

**Corresponding author: Email: deanuniversityaffairsslims@gmail.com & jayalakshmi.2k15@gmail.com;*

but also because they are prospective building blocks for more sophisticated nanostructures. NPs hold a unique place in nanoscience and nanotechnology, not only because of their unique features arising from their small size, but also because they are prospective building blocks for more sophisticated nanostructures [2-4].

A taxonomy of NPs is also offered, based on their size, shape, and chemical composition. The homogeneity and agglomerations of NPs are examined, with a specific focus on superparamagnetic NPs and their nanocomposites [5]. Copper (Cu) Nanoparticles, also known as Nano dots or Nano powder, are dark brown spherical metal particles with a large surface area. Nanoscale Copper Particles are generally 10-30 nanometers (nm) in size and have a specific surface area (SSA) of 30 - 70 m2/g. They are also available in 70-100 nm in size and have a specific surface area of 5 - 10 m2/g. Passivated, ultra-high purity, high purity, carbon-coated, and scattered Nano Copper Particles are also available. They're also available as a dispersion from the AE Nano fluid manufacturing team [2-4].

Nano fluids are described as NPs suspended in a solution utilizing either surfactant or surface charge technology. Organic phosphate ester media, ethanol, and mineral oil are examples of solvents. Technical assistance with Nano fluid dispersion and coating choices is also provided. Nano rods, Nano whiskers, Nano horns, Nano pyramids, and various nanocomposites are examples of other nanostructures. Surface functionalized NPs allow chemically attached polymers to preferentially adsorb the particles at the surface contact [6]. Metallic NPs (NPs) and their synthetic biology are an active subject in nanotechnology that fascinates academics as well as scientific research applications. Due to their enormous potential, these nanostructures, such as metal NPs, metal oxide NPs, magnetic NPs, and quantum dots, are a useful class of materials for biological sciences and engineering. For the production of one or more types of metal NPs, a variety of techniques, including physical and chemical approaches, are used [7]. Each of the chemical and physical synthesis techniques has certain drawbacks, such as inefficiency in terms of cost, the use of dangerous chemicals, the generation of poisonous end products, and the usage of high-energy processes. To address these issues, a more ecologically friendly and cost-effective biological synthesis mediated by plants or microorganisms has been largely embraced [8-10]. The plants and microbes provide useful compounds that exhibit different medicinal values [11-13].

2. MATERIALS AND METHODS

The chemicals used in the study were of analytical grade and procured from Himedia, India. The chosen strain *Saccharomyces cerevisiae* was obtained from a local patisserie. The *Saccharomyces cerevisiae* strain was sterile injected into the YPD broth (10 g/ l Yeast extract, 20 g/l Bacto peptone, 20 g/l Dextrose) and incubated for 24-48 hours. The broth was centrifuged for 10 minutes at 2000rpm, and the supernatant was collected and diluted in 30% ethyl alcohol before being incubated for 24 hours. The color of the sample was changed to a straw yellow hue. For 20 minutes, the sample is maintained in a water bath at 60 degrees Celsius. Drop by drop, 20ml distilled water + 0.05g titanium dioxide was added to the sample and incubated for 48 hours. The particle was recovered after centrifugation and diluted with 30 percent ethanol before being left undisturbed until dry [5]. The powder sample was taken as part of the characterization process. Sample diluted up to 10^{-9} to 10^{-1} and used to spread in a plate, nutrient agar. The four pathogens were isolated and gram-staining and biochemical tests were performed on them. The anti-oxidant properties of the extracts against the 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical was measured spectrophotometrically and butylated hydroxytoluene (BHT) served as the positive control [5]. The antibacterial impact of various Tio2 concentrations was investigated in this study. In addition, titanium dioxide NPs were used to test anti-diabetic capabilities [7,14].

3. RESULTS AND DISCUSSION

The antibacterial impact of various Tio2 concentrations was investigated in this study. In addition, titanium dioxide NPswere used to test anti-diabetic capabilities. The chosen strain *Saccharomyces cerevisiae* was obtained from Slayer's Lakshmi cakes & patisserie. We obtained the white precipitate of titanium dioxide, which was then centrifuged at 2000rpm for 10 minutes and incubated for 24 hours. It was then air dried till powdered and sent for characterization (Figs. 1 -3).

The average crystalline size D of the silver NPs was calculated from the diffractogram using the Debye-Scherrer formula, $D = 0.9/ 9\lambda/ \beta \cos\theta$, where λ is the full width at half maximum (FWHM) of a peak and is the wavelength of the X-rays employed for diffraction. Each of the four peaks was fitted using a Gaussian function to measure FWHM. The fitted gaussian curve's FWHM is used as the peak's FWHM [11].

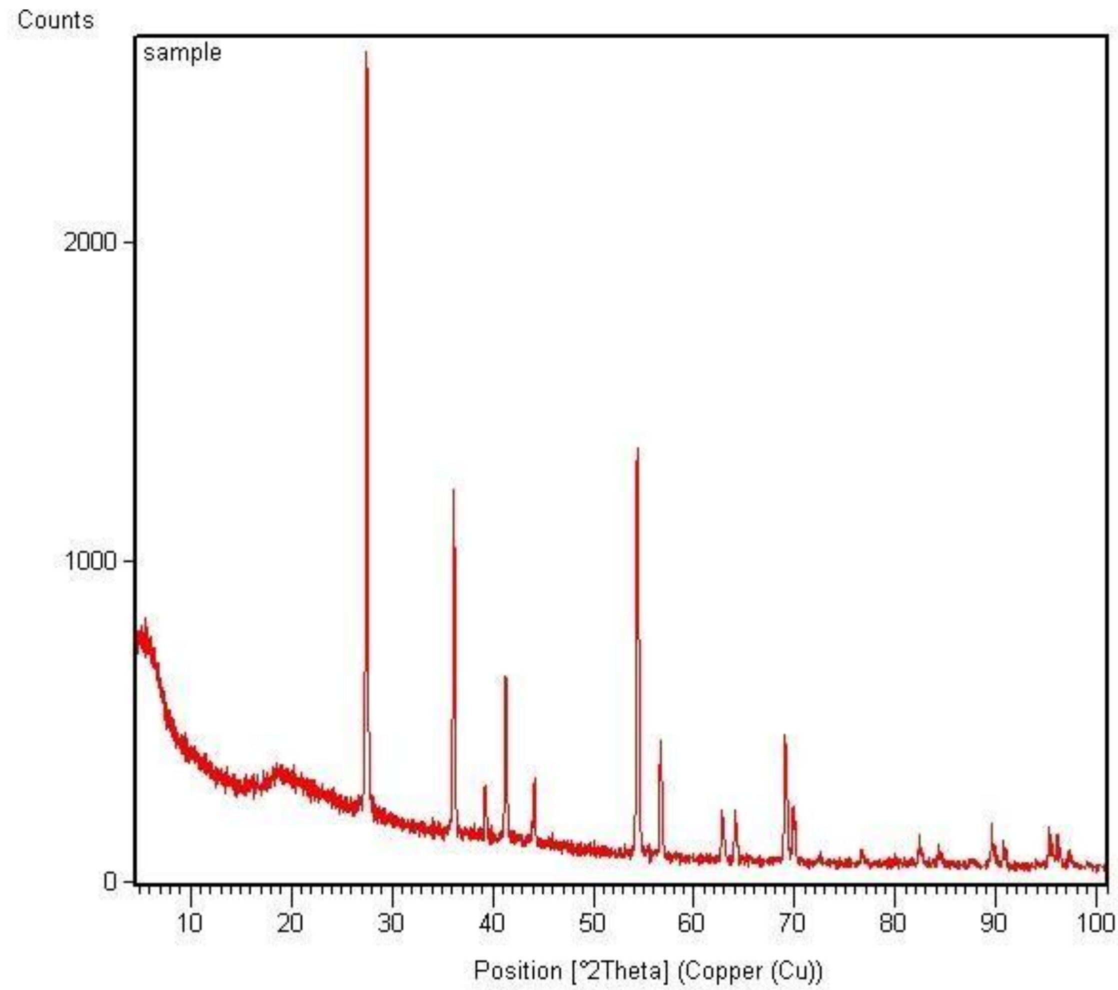

Fig. 1. SEM image of the sample

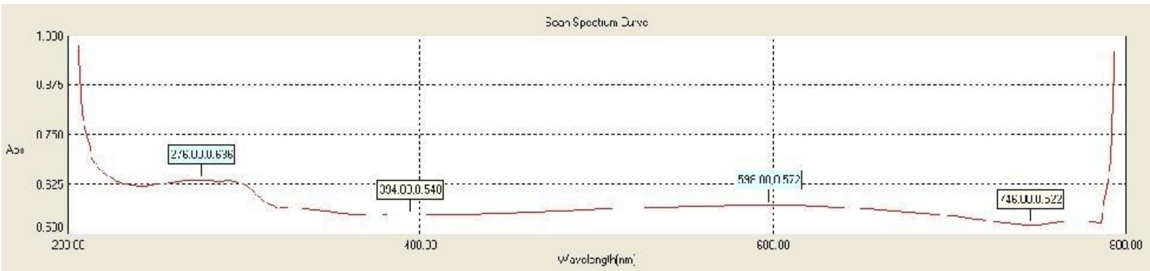

Fig. 2. XRD spectrum of the composite

Table 1. Clear Zone of inhibition was appeared around the sensitivity disc.

S.NO	ISOLATED ORGANISMS	20 µg/ ml	40 µg/ ml	60 µg/ ml	80 µg/ ml
1	*Staphylococcus* sp.,	12mm	15mm	23mm	24mm
2	*Bacillus* sp.,	14mm	18mm	20mm	22mm
3	*E.coli*	5mm	15mm	20mm	7mm
4	*Shigella* sp.,	18mm	20mm	25mm	10mm

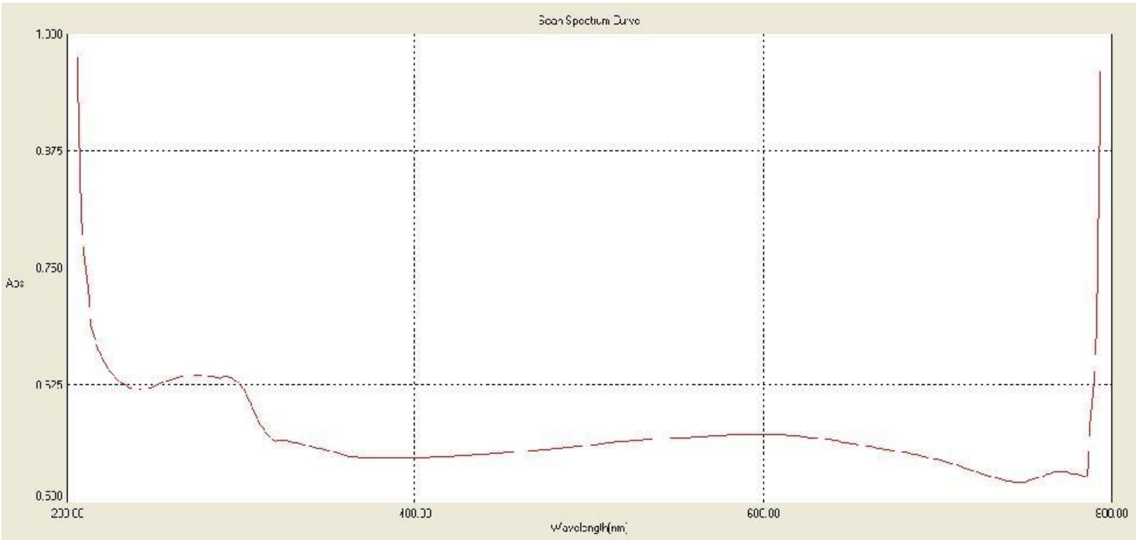

Fig. 3. Diffraction spectrum of the composite

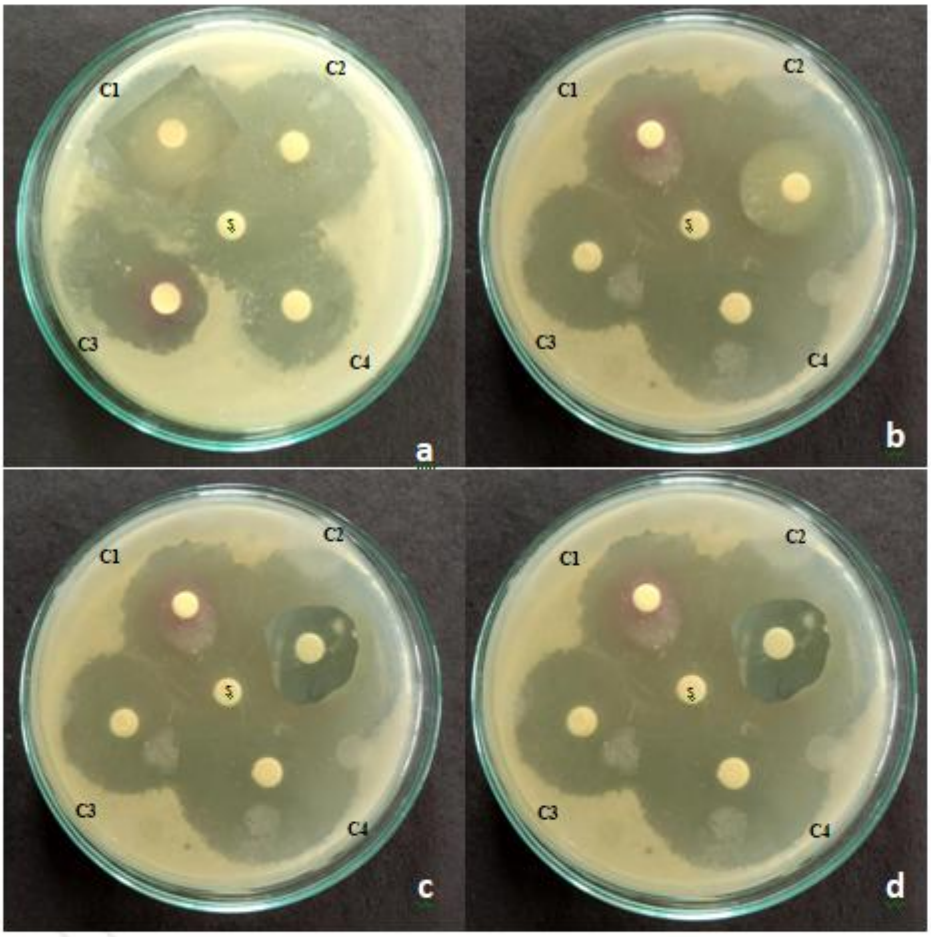

Fig. 4. Clear Zone of inhibition was appeared around the sensitivity disc

(a) *Staphylococcus,* (b) *Bacillus* sp., (c) *E.coli,* (d) *Shigella* sp., (s- standard disc (streptomycin (25µg/ mL)), C1, C2, C3 and C4 were 20, 40, 60 and 80 µg/ ml of synthesized TiO2 Nps)

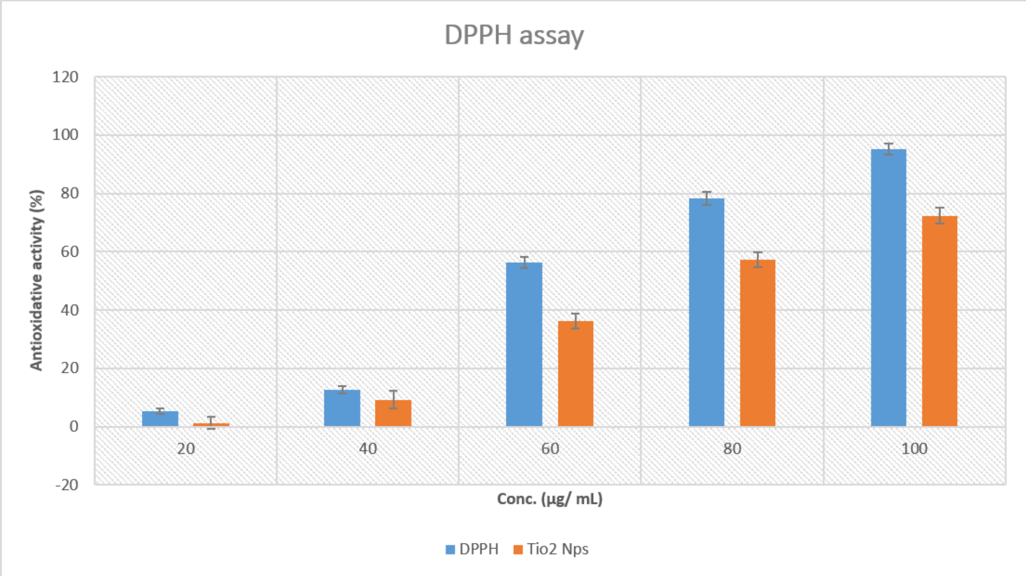

Fig. 5. Antioxidative activity (DPPH) of TiO2 NPs

The antidiabetic activity of titanium dioxide NPs was tested in the AVENZ Biotech lab private limited, Tambaram in Fig. 4. Tio_2NPs' high antioxidant ability was assessed using a DPPH radical scavenging experiment with an IC_{50} of 45.12 µg/mL (Fig. 5). As a benchmark, the BHT was used. The findings revealed that biosynthesized TiO2 NPs have strong antioxidant properties and might be employed as antimicrobial and neurodegenerative disease treatments.

4. CONCLUSION

The current research comprised a bio-safety assessment of TiO2 Nano particulate carriers for drug delivery. All future investigations on TiO2 NPs should characterize the physicochemical features of the NPs as supplied to the biological system, such as size distribution, crystalline structure, surface area, surface coating, and so on. This will allow for a more accurate comparison of data from various investigations and will aid in the calculation of suitable dosimetry.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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