Green Synthesis of TiO_2 Nanoparticles Using Extracts of Pomegranate Peels for Pharmaceutical Application

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ABSTRACT

Nanotechnology is prominent emerging technology which is being used in most of the fields like pharmaceutical, agriculture, biotechnology, electronics, etc. Green synthesis has been very significant for nanoparticle synthesis in today's scenario to avoid harmful use of solvents and other reagents. In the present study, successful attempt has been made to synthesis of titanium dioxide (TD) nanoparticles with the help of peel extract of pomegranate. The synthesized TiO_2 (TD) nanoparticles were characterized by SEM and FT-IR analysis. The particle size was in the range of 75-90 nm. Green synthesized particles in nano-size (less than 100 nm) are used in different medicines and also in cosmetics in the form of various cream lotion and talcum powder. In this way green synthesized TD has scope of application in pharmaceutical & cosmetic fields.

Key Words: Synthesized TD, nanoparticle, synthesis.

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INTRODUCTION

Nanotechnology is extremely vital space of research in trendy science and technology. Nanoparticles exhibit fully new or improved properties compared to larger particle of the majority of materials and these novel properties square measure derived due to the variation in specific characteristics like size, distribution and morphology of the particles [1]. Nanotechnology is emerged as speedily growing field with its application in science and technology for the aim of producing new material at the nanoscale level with environment friendly manner, i.e. minimum use of reagents, replacement of hazardous chemical processes, and lesser use of chemicals [2]. Nanoparticle synthesis in recent years has received respectable attention thanks to their distinctive properties and potential application [3]. The nanoparticle synthesis from plant extracts are found to be more reliable and eco-friendly compared with nanoparticles synthesized by different ways. The utilization of surrounding friendly materials for the synthesis of nanoparticles offer varied advantages in pharmaceuticals and medical specialty applications [4], as cyanogenetic chemical substances don't seems to be used in their synthesis. The scale and form of the nanoparticle forms the premise for its usage as antimicrobial, anticancer, anti-inflammatory drugs, and anti-diabetic agents. This paper centralized the green synthesis of TiO_2 nanoparticles with the help of pomegranate (*Punica granatum)* peel extract. This fruit is widely consumed recently and is processed as juice, jam and wine. This peel is wealthy supply of hydrolysable tannic acid referred to as punicalagin i.e. polyphenols [5]. Phenolic and acidic contents reduce the particle size of titanium tetra isopropoxide upto nanosize. The preferred particle size is less than 100 nm.

MATERIALS AND METHODS

For the synthesis of titanium dioxide nanoparticles, all the

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chemicals and reagents were purchased from Merck, India Ltd. Pomegranate peels were collected from the juice corner of local market of Dehradun. Pomegranate peels were collected and air dried for 2 days in air dryer and then grounded in mixer grinder. After that 4 g powdered peel of pomegranate was taken and extracted with 200 ml of distilled water at 90 °C. The extract was then stored in a reagent bottle for the synthesis of TiO_2 nanoparticle. For the synthesis of titanium dioxide nanoparticles 1N of titanium tetra isopropoxide was dissolved in 100 ml of distilled water; mixture was then kept on magnetic stirrer for continuously stirring. The fruit peel extract was added drop wise under constant stirring until pH of the solution became 7 [6]. Afterwards the mixture was subjected to constant stirring for 3 hours at room temperature. During this process the TiO_2 nanoparticles were prepared, separation of nanoparticles was carried out by filtration using whatman filter paper and for the removal of by-products, the product was washed with distilled water repeatedly. The obtained TiO_2 nanoparticles were dried at 90 °C in vacuum oven.

(a)

(b)

Fig. 1: (a) Dried Punica granatum peels, (b) Synthesized TiO_2 nanoparticles

OBSERVATIONS AND DISCUSSION

Figure 1 (a) and (b) show the photographs of dried peels of pomegranate and synthesized TD particles powder in nanosize respectively. The characterization of TiO_2 nanoparticles was done by SEM and FT-IR analysis.

FT-IR Analysis: The FT-IR spectra of reduced TiO_2 nanoparticles are shown in Fig. 2. All significant peaks confirm the structure of titanium dioxide synthesized in lab with the help of characteristic bonding. The peak at 643.55 cm^{-1} corresponds to C-Br stretching of halo compounds. The Band at 1075.92 cm^{-1} could be related to C-O stretching and O-H deformation of alcohols. The Band show -OH bending vibration at 1401.00 cm^{-1}, $-CH_3$ out of plane bending vibration. A sharp Band at 1635.27 cm^{-1} is related to C=C stretching vibrations of aromatic ring and also probably related to flavonoids and amino acids present in pomegranate peel. The peak at 3408.51 cm^{-1} corresponds to –NH groups and –OH stretching of carboxylic group.

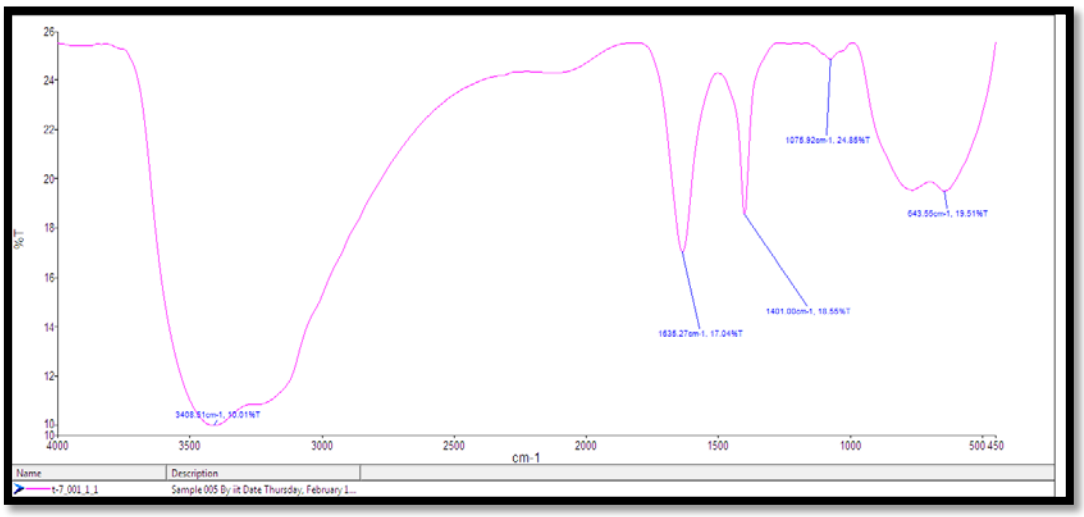

Fig. 2: FT-IR spectra of TiO_2 nanoparticles mediated by pomegranate peel.

Scanning Electron Microscopy (SEM) Analysis: For obtaining morphological data of synthesized nanoparticles the three dimensional images were obtained using SEM analysis (Sem-Analyser, IIT-Roorkee) in Fig.3. Both images (A and B) give information about the surface structure of TiO_2 nanoparticles and the size was observed in the range of 75-90 nm.

CONCLUSIONS

The nanoparticles of Titanium dioxide were successfully synthesized using *Punica granatum* peel extract in green synthesis method. According to FT-IR analysis the presence of vibration bands in TiO_2 nanoparticles were observed which confirmed the synthesis of TD particles and nano-size with morphology was confirmed by SDEM analysis, which show particles less than 100 nm which can be used in various pharmaceutical and cosmetic applications.

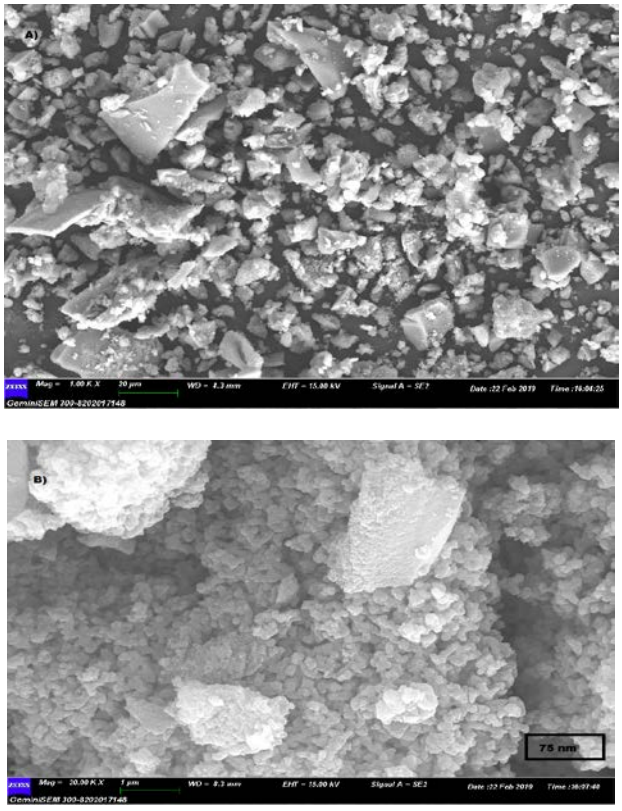

Fig. 3: SEM images of synthesized TiO_2 nanoparticles mediated by pomegranate peel extract.

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