SindhUniv. Res. Jour. (Sci. Ser.) Vol. 51 (2) 243-248 (2019)

http://doi.org/10.26692/sujo/2019.6.41

SINDHUNIVERSITY RESEARCH JOURNAL (SCIENCESERIES)

Green Synthesis and Characterization of TiO_2 nanoparticles using extract of *Alhagimaurorum* for the Treatment of Waste Water

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Received 5th January 2019 and Revised 12th May 2019

Abstract: Development of industries in the human based area became source of ecological contamination through accumulation of various health hazard pollutants into the water. Water is highly imperative treasure for living creature on earth because of its too much importance in physiochemical and for people's requirement. The objective of the current study is to synthesize the ecofriendly TiO_2 nanoparticles using extract of pharmaceutically important plant *Alhagimaurorum*. The studies plant was collected locally. The TiO_2 nanoparticles were prepared using the simple already reported method, by addition of TiO_2 into the crude extract until change in color occurs. The synthesis was confirmed through UV-spectroscopic andFourier-transform infrared spectroscopy, shape and size of particles were measure using scanning electron microscope. The elemental presence was assured through energy Dispersive X-ray spectrometric analysis. The result showed that color change, band shift confirmed the successful synthesis of TiO_2 nanoparticles. Maximum synthesized nanoparticles were round in shape with varying in size. The waste water cleaning efficacy of prepared nanoparticles was analyzed. The prepared TiO_2 nanoparticles significantly reduced the total dissolved salt contents and hardness of water. Therefore these synthesized TiO_2 nanoparticles could be the best source for cleaning of waste water particularly hardness and total dissolved salts from waste water without spoiling quality of water.

Keywords: TiO_2 nanoparticles; Waste Water; *Alhagimaurorum*; Green Synthesis

1. INTRODUCTION

Water is highly imperative treasure for living creature on earth because of its too much importance in physiochemical and for people's requirement. Recently, due to its increasing price of human use, people's growth, different weather problem and ecological contamination water is highly ample resources. As per world health organization roughly above 1.1 billion human are affected because of poor availability of proper human use water. The worry can be decreased through cleaning the waste water which could be highly significant substitute option best available (Das, *et al.*, 2018) (WHO (World Health Organization).

Development of industries in the human based area became source of ecological contamination through accumulation of various health hazard pollutants into the water. Organic chemical that creates contamination are various groups of colored dyes and derivatives of phenol (Gautam, *et al.*, 2018). An organic chemical with red in color phenol red is highly poisonous producing water contamination. Phenol red highly recommended for pH pointer and act as weak acid which is the ordinary arrangement of sulfo-nephthaleins. It has variety of uses especially in pigment industries, chemical producing factories, petroleum based industries and medicine manufacturing industries. Various chemical from industries when disposed through different events, mostly marks in dangerous troubles like interrupting the development of microorganism, decreasing the light infiltration, growing the chemical oxygen demand and clarity of water (Chahkandi, 2017) (Lupa, *et al.*, 2018)..

Nowadays less developed countries are facing the troubles for clean water for drinking. The whole globe is facing the difficult tasks in managing the requirements of safe water, these challenges because of maximum dryness, increase humans, various health based regulations and various need of consumers. Healthy safe water free from microbes is very important for humans (Tiwari, *et al.*, 2008)(US Bureau of Reclamation and Sandia National Laboratories, 2003).(US Environmental Protection Agency, 1999).

The enormous research on TiO_2 has been evident from literature in various areas of basic and applies sciences because of its high reducing capacity for the breakdown of organic contaminants, without any side effects, minimum price, elemental strongest, rich resilience and visible life transparency (Schneider, *et al.*, 2014). However, the fast reconstruction of light-generated electrons the quantum product of TiO_2 is decreased. That's why these disadvantages of the

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$TiO_2$for ecological formulations with sun light and oxygen. Nowadays, many scientist concentrate on this subject for enhancing the potential of TiO_2 pharmacological applications (Nwankwo, *et al.,* 2019).

Alhagimaurorum is a pharmacologically vital herb and used for normally for the management of kidney diseases, piles migraine, arthritis, warts etc. Different range of biologically active phytochemicals such as steroids, flavonoids and alkaloids and various others have been isolated from *A. maurorum*. The enormous class of pharmacological potentials such as antidiarrheal, antipyretic, anti-inflammatory and many others. More importantly *A. maurorum* have the big amount of digestible proteins and essential salts(Ahmad, *et al.,* 2015)(Muhammad, *et al.,* 2015).

2. MATERIAL AND METHODS

Collection of plant

Alhagimaurorum was collected from Jamshoro most of the collection as from University of Sindh, Jamshoro. Plant was identified and confirmed by Dr. Jamal Mangi, assistant professor Institute of Plant Sciences, University of Sindh, Jamshoro

Extract preparation

The collected plant *Alhagimaurorum* was initially cleaned with distilled water until it was free from all pollutions. The plant was then cut into very small pieces and poured into 1L of methanol in a flask for one week and mixture was stirred daily with cleaned steel rod for better mixing. After one week methanol was evaporated using rotary evaporator and plant extract was obtained in solid form. The extract was used synthesis of TiO_2 nanoparticles.

Synthesis of TiO_2 nanoparticles

Titanium dioxide was purchased from Sigma Aldrich (CAS. 13463-67-7). *A. maurorum* dried extract was again dissolved in distilled water and after that placed in a glass flask and 1 mM solution of TiO_2 was added drop by drop and kept in incubation with stirring till the change of mixture color from yellow to brown color. Change of color specifies the foundation of TiO_2 nanoparticles.

Characterization of TiO_2 nanoparticles

The synthesized TiO_2 nanoparticles were inspected by Ultra Violet visible spectroscopic examination. The form and size of the prepared TiO_2 nanoparticles were calculated by means of a scanning electron microscope (SEM). Fourier-transform infrared spectroscopy (FTIR) was achieved by construction of potassium bromide (KBr) round on crushing TiO_2 nanoparticles with KBr tablets and measured on instrument. Energy Dispersive X-ray spectrometric analysis (EDS) was done to verify the presence of TiO_2 and elements in crude extract and in TiO_2 nanoparticles.

Collection of waste water sample

The samples of waste water were collected from the Phuleli canal in which much domestic sewage from local homes and industries.

Treatment of sewage waste

Local effluents were tested with TiO_2 nanoparticles and crude extract for two days at neutral pH.

Analysis of total dissolved solid

The waste water samples were treated with TiO_2 nanoparticles and crude extract of *A. maurorum.* After treatment, the samples were filtered and the remaining residue dried in oven. After that the residues weight were recorded.

Analysis of hardness level

TiO_2 nanoparticles were added in waste water and one or two drops of eriochrome black T (EBT) was poured in it. The mixture was the titrated with ethylene diaminetetraacetic acid (EDTA) till the mixtures color change occurs.

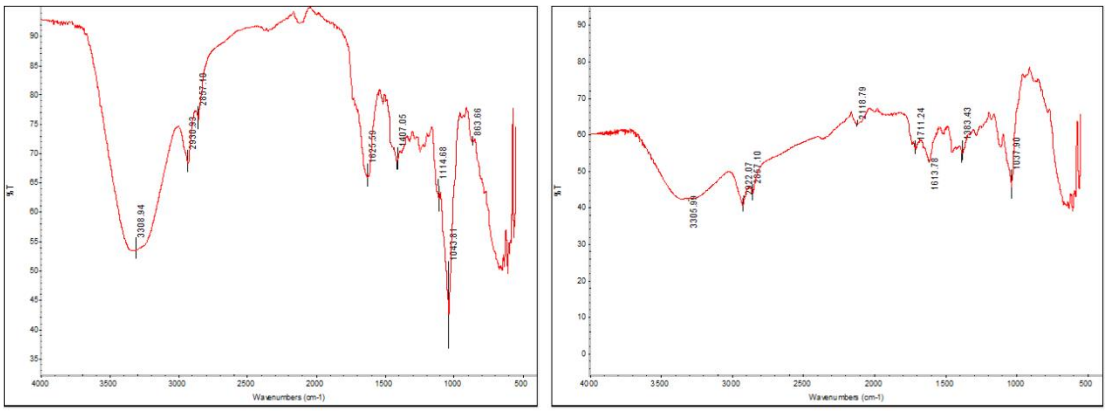
3. RESULTS

Synthesis and UV-visible spectroscopic examination

The synthesis of TiO_2 nanoparticles by *A. maurorum* extract was examined by using spectroscopic analysis. While the addition of TiO_2 into the extract the slow change in color indicates the preparation of TiO_2 nanoparticles. The shift in absorption signal from low to high nm with increasing incubation and change in pH occurs in TiO_2 nanoparticles.

FTIR examination

FTIR dimensions of TiO_2 prepared by using *A. maurorum* extract. The FTIR was examined in order to confirm the creation of TiO_2 nanoparticles. The IR group deceptive at 863.33 cm^{-1} in crude extract is representative of the Oxygen–Hydrogen and it was transferred to 1037.30 cm^{-1} in TiO_2 nanoparticles. Another noticeable alteration in the trend facts equivalent to amide 2930.90 to3305 cm^{-1} recommended that participation of $–NH_2$ and COO^- in crude extract production exterior TiO_2 constant **(Fig 1).**

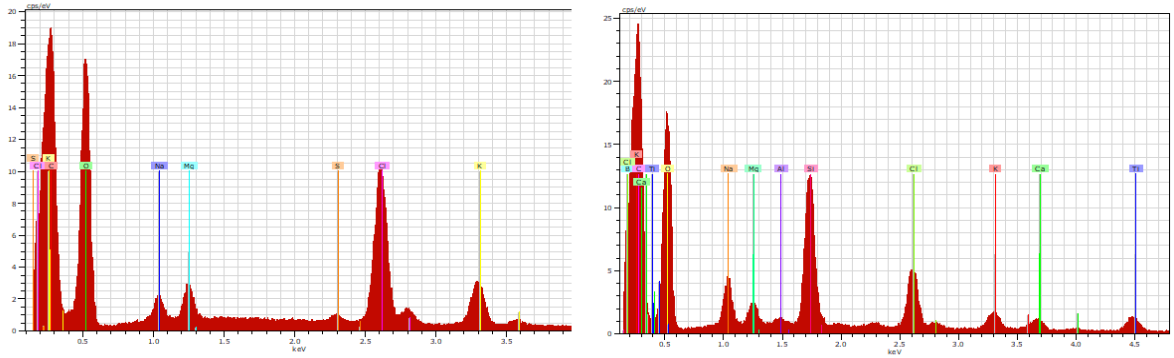


(A) Alhaji mauroorum **extracts** **(B) TiO2 nanocatalyst of *Alhaji mauroorum***

Fig. 1. FTIR pattern of (A) plant extract and (B) TiO_2 nanoparticles

EDS examination

The TiO_2 nanoparticles and crude of selected plant were inspected for elemental inquiry and occurrence of TiO_2 using energy dispersive X-ray spectrometric (EDS) technique. Spectrum presented in **(Fig. 2)** showing the EDS spectrum of plant extract and prepared TiO_2 nanoparticles prominent pointers in EDS spectrum in TiO_2 area approves the amalgamation of the TiO_2 nanoparticles.

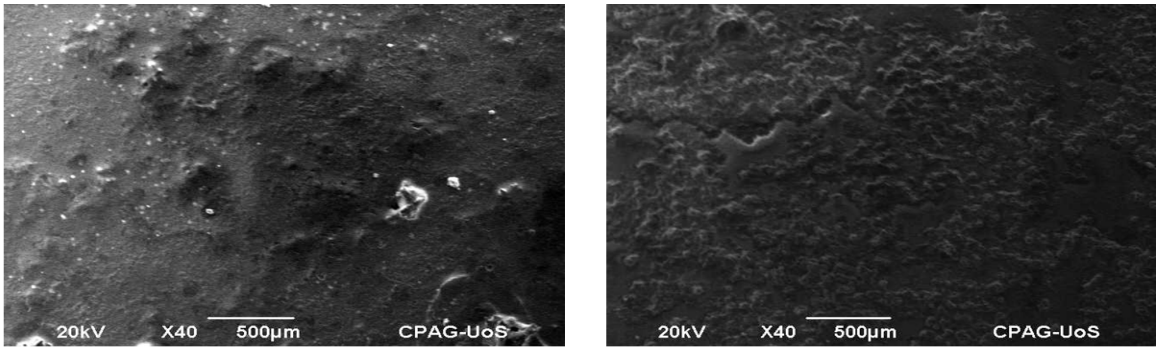


(A) Alhaji mauroorum **extracts** **(B) TiO2 nanocatalyst of *Alhaji mauroorum***

Fig.2.EDS Plot of (A) plant extract and (B) TiO_2 nanoparticles

Scanning electron microscopy (SEM)

Scanning electron microscopy examination carried out in order to determine the size and shape of TiO_2 nanoparticles. The SEM figure showed that majority of the TiO_2 nanoparticles were in round in shape and size of prepare nanoparticles were 50-100nm **(Fig 3).**



(A) TiO2 nanocatalyst of *Alhaji mauroorum* ***(B) Alhaji mauroorum*** **extracts**

Fig. 3.SEM photographs ofof (A) TiO_2 nanoparticles and (B) plant extract

TDS analysis

In water the total amount of organic and inorganic salts designated as total dissolved solids. The major portions of TDS are mainly hydrogen carbonate, potassium, calcium, sodium and sulphate. When the waste water samples were treated with the prepared TiO_2 nanoparticles, results indicated that TiO_2 significantly removed the TDS in comparison to crude extract **(Fig. 4)**

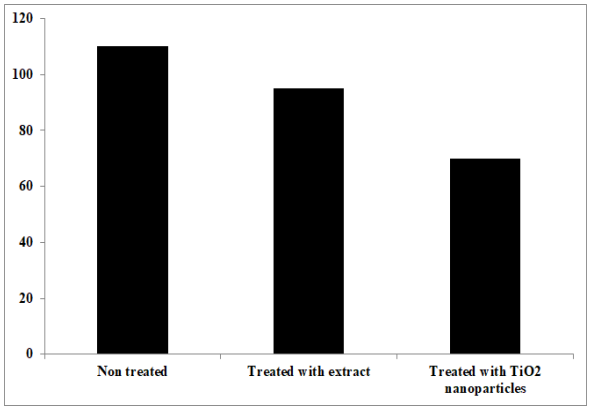


Fig. 4. Effects of plant extract and TiO_2 nanoparticles on removal of TDS from water

Hardness

Hardness of water is very essential parameter. Results showed that highly significant reduction in hardness occurs when the samples were treated with TiO_2 nanoparticles in contrast to extract reduce the hardness in moderate level **(Fig. 4).**

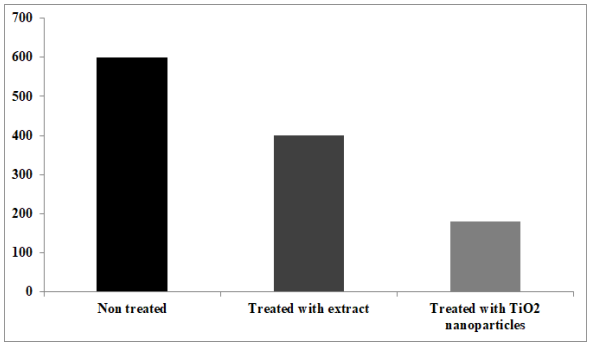


Fig. 5. Effects of plant extract and TiO_2 nanoparticles on removal of hardness from water

4. DISCUSSION

Recently, nanoparticles prepared from medicinal plants are widely used in rate limitation and environmental friendly for the purification of waste water. Therefore, different nanoparticles have been used for the cleaning of different types of waste water with particular parameters, TiO_2 and silver nanoparticles have been effectively used because of its very encouraging outcomes have been published by may researcher and scientist for the elimination of different contaminants from waste water (Haolat, *et al.*, 2018).

Removal of chromium, sulphate and other organic and inorganic pollutants while cleaning domestic and industrial waste water and also removal of several dyes and colored compounds from industrial waste water are the best examples of various nanoparticles particularly TiO_2 nanoparticles synthesized using different medicinal plant extracts (Cervantes-Avilés, *et al.*, 2018) (Puyol, *et al.*, 2017)..

Total amount of magnesium and calcium ions present in water is termed as hardness of water. As per environmental protection agency (EPA) waster is categorized into four different groups. Such as soft, moderate, hard and very hard, (0-50, 50-150, 150,300 and >300mg/L respectively). Hardness major portion is magnesium and calcium with minor trace quantity of other metals (Sharmila *et al.*, 2013). If the water is hard or very hard it's very dangerous for human health as well as aquatic life. Our prepared TiO_2 nanoparticles have significantly reduces the hardness of waste water. Therefore these synthesized TiO_2 nanoparticles could be the best source for cleaning the waste water particularly hardness and Total dissolved salts.

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