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Research Article

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Green Synthesis of Iron Nanoparticles from the *Solanum torvum* Flower Extract and their Antibacterial Activity

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Abstract The green synthesis of nano particles involving plant extract has attracted the attention of researchers. In the present research program, the morphology of Iron nanoparticles was confirmed by Scanning Electron microscopy(SEM). we are reporting a novel biological approach for the formation of Iron nanoparticles using solanum torvum flower extract. Copper sulphate was made to reduce with aqueous solution of *solanum torvum* flower extract. Scanning electron microscopy (SEM) suggested shape of the nanoparticle. Particle size analyzer confirms the particle size of the formed iron nanoparticles. UV-Visible absorption shows characteristic absorption peak of iron nanoparticles. Antibacterial studies confirm its potentiality against both Pseudomonas and Proteus bacteria.

Keywords Copper sulphate, solanum torvum extract, UV-Vis, SEM, antibacterial study

Introduction

Green synthesis provides more advantages over chemical and physical methods as it is cost effective and environment friendy. In this method, there is no need to use high pressure, energy, temperature and toxic chemicals [1]. Green synthesis offer better manipulation and their stabilization. This has motivated an upsurge in research on the synthetic routes that allows better control of shape and size for various nanotechnological applications.

Iron nanoparticles are sub-micrometer particles of iron metal. They are highly reactive because of their large surface area. In the presence of oxygen and water, they rapidly oxidize to form free iron ions. They are widely used in medical and laboratory applications and have also been studied for remediation of industrial sites contaminated with chlorinated organic compounds [2]. Applications of iron nanoparticles include terabit magnetic storage devices, catalysts, sensors, and high-sensitivity biomolecular magnetic resonance imaging (MRI) for medical diagnosis and therapeutics [3]. These applications require coating of the nanoparticles by agents such as long-chain fatty acids, alkyl-substituted amines and diols. Additionally, the nanoparticle-water slurry can be injected into the contaminated area and stay there for long periods of time [2]. These factors combine to make this method as cheaper than most currently used alternative methods.

Magnetic Iron nanoparticles have shown great potential in many biological and biomedical applications such as targeted drug delivery, magnetic fluid hyperthermia, magnetic resonance imaging, and tissue engineering. These include organic solvent heating method, polyol method, and co-precipitation method [4-8]. The co-precipitation method is the most effective technique for preparing aqueous dispersions of iron oxide nanoparticles because the synthesis is conducted in water. For this report, we studied several biological molecules as surface coatings to achieve biocompatibility such as gluconic acid (GA), lactobionic acid (LBA), and polyacrylic acid (PAA). These molecules were used to control the particle size, to prevent the nanoparticles from aggregation, and to achieve biocompatibility. The pharmacological activities were wide including anti-oxidant activity, antifungal activity, antibacterial activity, antiulcer activity, antihypertensive and metabolic correction activity, nephroprotective activity, cardioprotective activity, antidiabetic activity, analgesic and anti-inflammatory activity.

Experimental Methods

Iron nanoparticles were synthesized according to the chemical reduction method by using flower extract. This method can easily be performed in any chemical laboratory and cheaper method in comparison with other methods of synthesizing Iron nanoparticles.

Synthesis of *Solanum torvum* flower extract

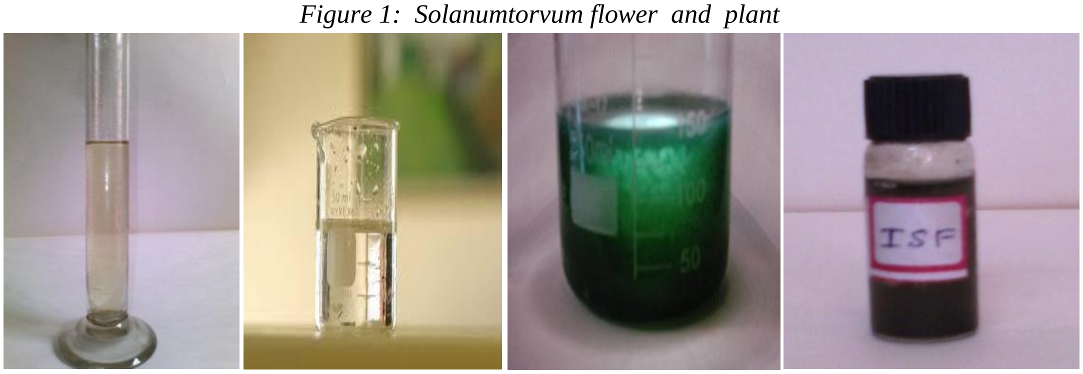
Fresh *Solanum torvum* flower have been collected from our college campus. It is well cleaned with ordinary water and rinsed two times with distilled water. It is then dried. Exactly, 5g of well cleaned it is weighed accurately in an analytical balance. It is then transferred into a cleaned morter and pestle, it is crushed well and transferred into a 250 ml beaker. 100 ml of distilled water is added to it. It is then boiled for 20minutes and filtered through a Whatmann 40 filter paper. The extract collected is stored for the reaction.

Synthesis of Iron Nanoparticles

0.0765 N of FAS solution is used in this synthesis. 10 ml of freshly prepared FAS is taken in a cleaned 100 ml beaker. About 5ml of the *Solanum torvum* flower extract is measured using a measuring cylinder and poured into the beaker. By adding the extract, we can observe the colour change. White colour of FAS changes to greenish black colour indictes that the reaction has started. The reaction will be completed within 30 minutes.

As shown in Figs below the color of the $Fe^{3+/}$ in Solanum torvum flower extract solutions at room temperature rapidly changed from light yellow to greenish black, indicating the formation of FeNPs. This is concluded by measuring the absorbance by UV–visible spectrometer.

Figure 1: Solanumtorvum flower and plant



(a) (b) (c) (d)

Figure: 2a Flower extract of S.torvum , 2b. 0.3N FAS solution , 2c.Iron nanoparticles after addition 2d. Iron nanoarticles after 30 minutes

Results and Discussion

UV-Visible spectroscopy

Ultraviolet-visible spectroscopy (UV-Vis) refers to absorption spectroscopy in the UV-Visible spectral region at **327**, 297, 263, 217 nm in fig.3. The absorption in the visible range directly affects the perceived color of the chemicals involved. In this region of the electromagnetic spectrum, molecules undergo electronic transitions. The UV Visible spectrum of FeNPs in the aqueous BS extract is shown in Figure. The two absorption peaks at wavelengths of nm indicate the formation of iron nanoparticles.

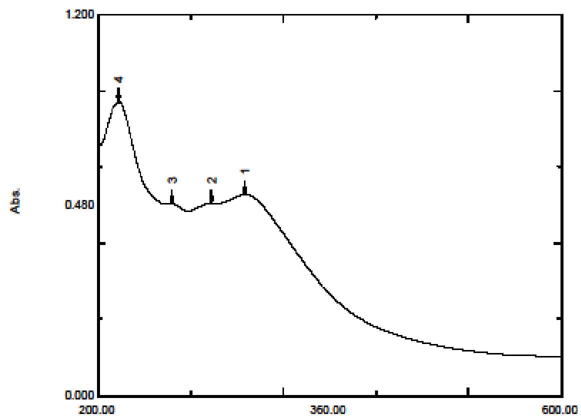


Figure 3: UV-Visible Spectrum image of FeNps

Scanning Electron Microscope (SEM)

SEM picture indicates the nanoparticle as spherical shape and its size varies from 59.80 nm to 91.60 nm in the present work, there is no stabilising agent used to prevent agglomeration. Naturally, the size increases as the time increases.

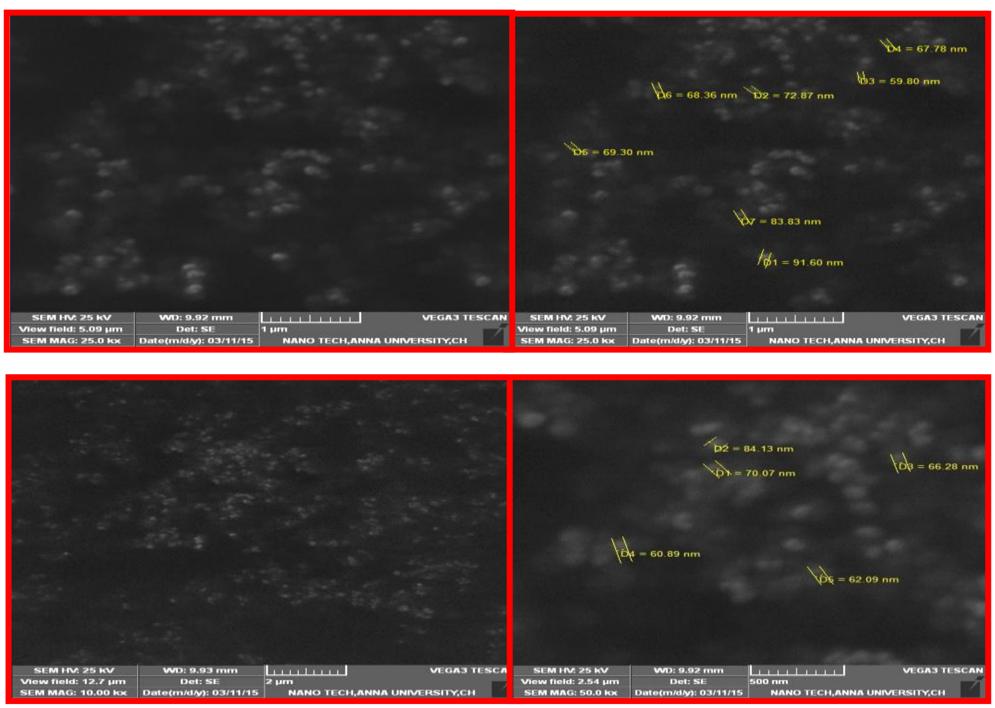


Figure 4: SEM image of FeNps

The SEM micrographs of the sample ISF is shown in the fig 4- a,b,c,d. The SEM picture of Iron nanoparticles are shown in resolution with scale bar 1micrometer. The particle size distribution of Iron nanoparticles of sample ISF is shown in the fig.4. The Iron nanoparticles are associated with one another and forms clusters. It leads to agglomeration of Iron nanoparticles after 30 minutes.

The Particle Size Analysis (PSA)

The particle size analysis shows that the average size Iron nanoparticles of sample of ISF is 1244 nm as shown in the fig 5. This may be because of translational diffusion coefficient, which will not depend only on the size of the particle 'core', but also on any surface structure, as well as the concentration and type of ions in the medium. It is important to note that dynamic light scattering produces an intensity weighted particle size distribution, which means that the presence of oversized paricles can dominate the particle size result.

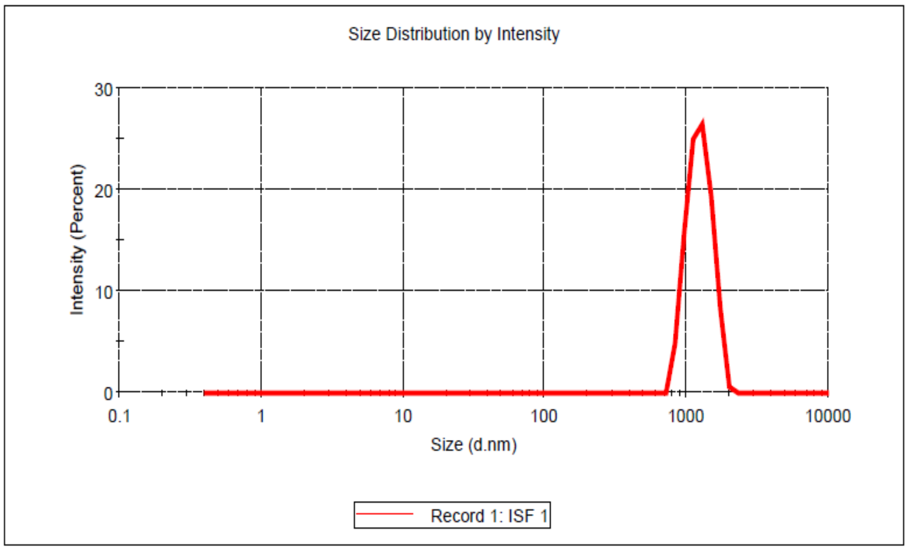


Figure 5: Particles Size Analysis image of FeNps

Antibacterial Activity of Iron Nano particles

In this work, studies over the FeNps synthesized by *Solanum torvum* flower extract showed the zone of inhibition against Pseudomonas of 22 to 24 mm. both Pseudomonas and Proteus are highly stable and showed significant antibacterial action on both the gram classes of bacteria compared to larger size synthesized FAS nanoparticles and showed that the synthesized nanoparticles using Solanum torvum flower extract has higher antibacterial effect on after 96 hr growth [9-10]. A very minimum concentration of 0.0765N come of the FAS used for this purpose. This paper provides an overview of the current research activities that center the biological synthesis and the study of iron nanoparticles, which have shown positive and negative impact on the micro-organism and the plants.

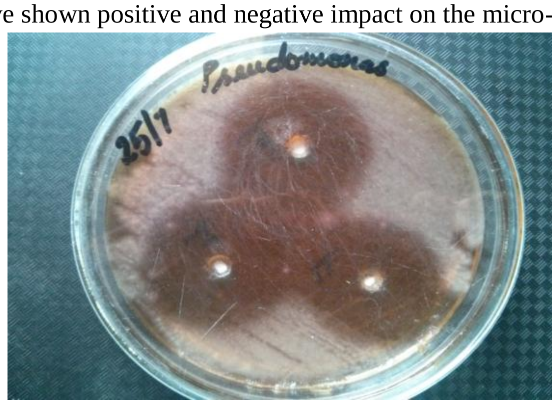


Figure 6a: Antibacterial activity image of Pseudomonas of FeNps

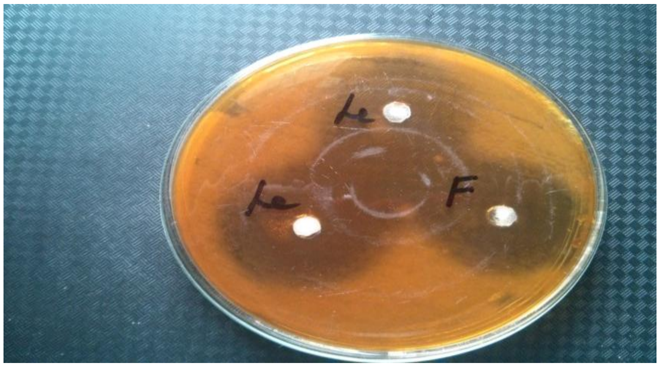


Figure 6b: Antibacterial activity image of Proteus of FeNpS

Conclusion

In the present work, we attempted to synthesize the iron nanoparticles by green synthesis. We used *Solanum torvum* flower extract for this purpose. The SEM images of the nanoparticle suggested that it is spherical shape of variable size, Particle size analyser also confirmed the nanoparticle formation. Its antibacterial activity towards shows its potentiality for biological application [9-12]**.** Biosynthesis of FeNPs using green resources is a simple, environmentally friendly, pollutant-free and low-cost approach. Functional bioactivity of FeNPs (antibacterial studies) is comparably good.

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