Green synthesis And Antimicrobial activity of Iron nanoparticles Using MangiferaIndica leaf Extract

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Abstract: Green synthesis of iron nanoparticles being cost effective and eco friendly treatment technique, is gaining importance nowadays. The aim of the present study is to prepare leaf extract, precursor, and synthesis of iron nanoparticles by green techniques. The synthesized nanoparticles are characterized by UV-Visible spectrophotometer, X-ray diffraction analysis .(XRD), Scanning Electron Microscopy (SEM) and Energy dispersive X-Ray analysis (EDX). The characterization results confirm the formation and presence of iron nanoparticles and biomolecules which could help in capping the nanoparticles. The antimicrobial study of the Iron nanoparticles was established using gram positive bacteria (Bacillus cereus and Staphyloccocusaureus) and gram negative bacteria (Escherichia coli, Klebsiella pneumonia).

Key words: UV, XRD, SEM, EDX

1.INTRODUCTION

The field of nanotechnology is one of the most active areas of research in modern materials science. Nanoparticles exhibit completely new or improved properties based on specific characteristics such as size, distribution and morphology. New applications of nanoparticles and nanomaterials are emerging rapidly [1]. The nano meter scale is commonly indicated as 1-100nm, but nano science and nanotechnology often deal with objects larger than 100nm [2]. Nano materials are materials that consist of nanoparticles with improved physical and chemical properties such as lower weight with higher strength [3-5]. Nanoparticles are a special group of materials with unique features and extensive applications in diverse fields. It is being utilized as therapeutic tools in infections, against microbes thus understanding the properties of nanoparticles and their effect on microbes is essential for clinical applications [6].Nanomedicine has found wide applications in drug delivery [7], gene delivery, molecular diagnostics [8], fluroscent biological labels [9], cardiovascular [10], cancer imaging purposes [11], detecting anti- microbial activity, detection of protein analyzes, purification of biomolecules and cells, and many others.

Iron is one of the essential elements for plant growth and plays an important role in the

photosynthetic reactions. Iron activates several enzymes and contributes in RNA synthesis and improves the performance of photosystems [12]. Iron nanoparticles are also useful in cleaning up organic pollutants in groundwater because they can donate electrons to more electronegative atoms, such as chlorine atoms, present in many of the molecules that make up organic pollutants [13]. In recent, green synthesis of Iron nanoparticles was achieved by using microorganisms, plant extract [14]. Mango leaves can be used to treat diarrhoea, fever, and hypertension. Mango leaves can also be used to lower high blood pressure. This is also able to treat anxiety in individuals Mango leaves are used to treat whopping cough, asthma, bronchitis and cold. Therefore it is considered as a good tool in treating respiratory disorder.

Mango leaves showed antimicrobial, antioxidants and antidiabetic activity. disease. Mango leaves containing organic compounds tarakserol-3 beta and ethyl acetate extract synergism with insulin activates GLUT4 and stimulates the synthesis of glycogen, so it can reduce the symptoms of hyper glycemia [15].In the present study the iron nanoparticles are synthesized using *Mangifera Indica* leaf extract. The purpose of this study is to describe a simple way for preparing iron nanoparticles. Pure iron nanoparticles have been synthesized and characterized herein.

2. EXPERIMENTAL

2.1. Material and methods

Ferric chloride is obtained from Sigma Aldrich Chemicals merk specialties private limited. Mangifera Indica leaves were collectedfromAzhahiamandabam,Kanyakumari, Tamilnadu, India

2.2. Preparation of leaf Extract The leaves are thoroughly washed with de ionized water, the washed leaves (350g) were cut and boiled with 500ml of de ionized water for 15min in a heating mantle at temperature 80^{o}C. The extract was then filtered using whatman's no.1 filter paper. The filtrate was collected in a clean and dried conical flask by standard sterilized filtration method and was stored in a refrigerator for further use.

2.3. Synthesis of iron nano particles Iron nanoparticles were synthesized by taking 5ml of mango leaves extract and then it was added into 0.1M of 5ml aqueous solution of ferric chloride solution and stirred at room temperature. The procedure was repeated for 15ml, 20ml and 25ml extract but the metal used only 5ml $FeCl_3$ throughout the experiment. Then pH was noted using the Eutech pHmeter. The prepared iron nanoparticles solutions thus obtained was purified by repeated centrifugation at 15,000rpm for 15min. The synthesized nanoparticles were taken for further characterization study.

3. RESULT AND DISCUSSION

3.1. UV-Vis spectroscopy

The bio reduction of Iron in aqueous solutions was monitored by periodic sampling of aliquots of the mixture and subsequently measuring UV–Vis spectra. UV-Vis spectral analysis was done

by using UV-Vis spectrophotometer at the range of 200-800nm and observed the absorption peak at 216-265nm region due to the excitation of surface plasmon vibrations in the iron nanoparticles [12]. The UV-Visible peak of iron nanoparticles using Mangifera indicaleaves extract at 223.62nm(figure:1).

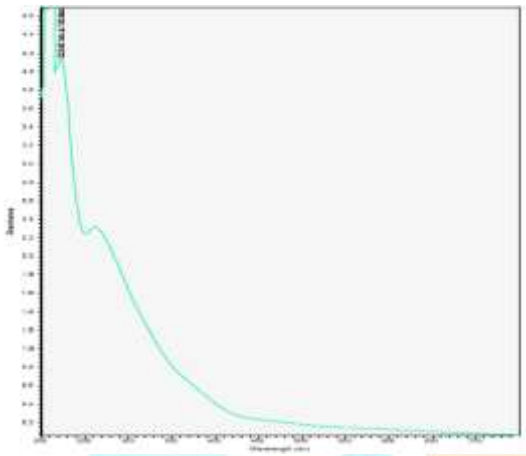

Figure: 1. UV-Vis Spectrum of iron nanoparticles using MangiferaIndica leaf extract

3.2. X-Ray Diffraction studies

The phase identification and crystalline structures of the nanoparticles was characterized by X-ray powder diffraction [16]. Iron nanoparticles synthesized using Mangiferaindica leaves extract is shown in Figure :2. It is found that there exist strong diffraction peaks with 2θ values of 28.1°, 40.3° and 11.9° corresponding to the crystal planes of (111), (121) and (100) of crystalline iron nanoparticles respectively.

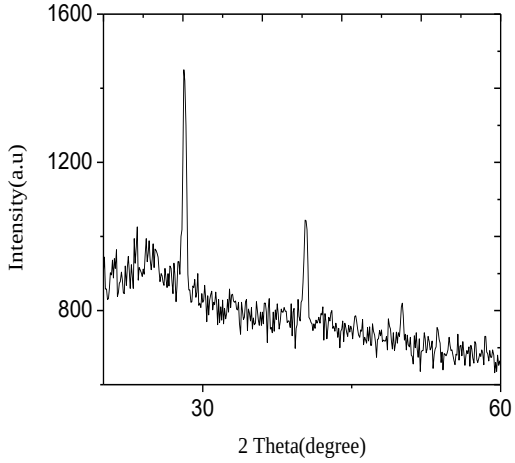

Figure: 2. XRD pattern of iron nanoparticles using MangiferaIndica leaf extract

The Size determination from XRD by Using Debye-Scherrer's formula is used to calculate the crystalline size of the nanoparticles.

$D(nm) = K\lambda / \beta_{1/2} \cos\theta$ Where, d - the average particle size in nm, λ - the wave length of the X ray (0.15406nm), $\beta_{1/2}$- the full of the peak at half height in radius, θ - the Bragg diffraction angle in degrees.

3.3. Scanning Electron Microscopy

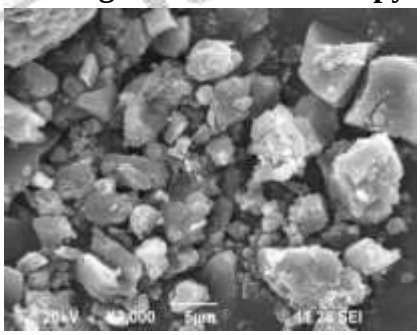

Figure: 3. SEM image of iron nanoparticlesusing MangiferaIndicaleaf extract

The morphology of Iron nanaoparticles was examined by SEM [17]. Dried suspension of Iron nanoparticles synthesized by reduction using Mangiferaindica leaves extracts [18]. The SEM image of iron nanoparticlesfromMangiferaindica leaves extract is given in Figure: 3

3.4.EnergyDispersiveX-ray spectroscopy

EDX analysis data confirms that the main components of the materials. Energy dispersive X-ray microanalysis (EDXMA), is an analytical technique used for the elemental analysis or chemical characterization of a sample [19]. Nanoparticles are synthesized using Mangiferaindica leaves extract the weight percentage of iron as 11.38% (figure:4).

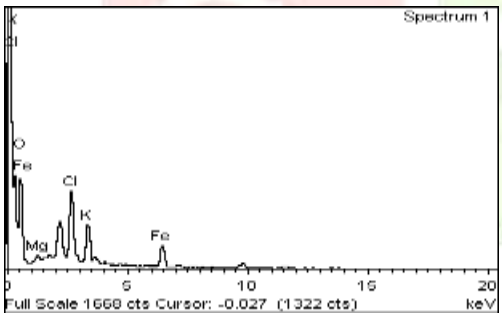

Figure: 4. Energy Dispersive X-rays spectroscopy of iron nanoparticles from MangiferaIndica leaf extract

3.5. Antimicrobial Activity

Antimicrobial activities of the iron nanoparticles was determined by well diffusion method using Gram positive (Bacillus cereus and Staphyloccocusaureus) and Gram negative (Escherichiacoliand Klebsiellapneumonia) bacteria. Fresh bacterial culture of 0.1ml having 108 CFU was spread on nutrient agar (NA) plate using swab. Wells of 6 mm diameter were punched off into medium with sterile cork borer and filled with 50µl of samples using micro pipette in each well at aseptic condition. Plates were then kept in a refrigerator to allow pre-diffusion of extract for 30minutes. Further the plates were incubated in an incubator at 37^0C for 24hours. The antimicrobial activity was evaluated by measuring the zone of inhibition.

Iron nanoparticles prepared using Mangiferaindia leaves extract the zone of inhibition produced in Escherichia coli (18mm), Klebsiella pneumonia (16mm),Bacillus cereus (16mm), and Staphylococcus aureus (18mm). It is proved that the zone of inhibition produced by Mangiferaindica leaves extract in Escherichia coli(18mm) and Staphylococcus aureus (18mm) is more active (figure : 5).

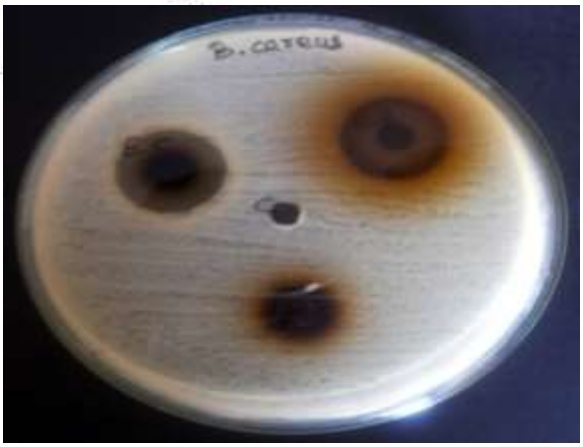

Figure: 5. Antimicrobial activity of iron nanoparticles from MangiferaIndica leaf extract

Table.1 Antibacterial zone formation

Species	M.Indica(zone of inhibition)
Escherichia coli	18mm
Klebsiellapneumonia	16mm
Bacillus cereus	16mm
Staphylococcus aureus	18mm

6. CONCLUSION

The study demonstrates the rapid synthesis of iron nanoparticles with small sized and high crystallinty. The absorption peak of iron nanoparticles prepared using Mangiferaindica leaves extract at 223.62nmconfirmed the particles are nano in size. XRD study reveals that the iron nanoparticals formed are crystalline in nature. The surface morphology was studied by SEM. EDX study confirmed that the presence of iron metal in the sample under studies. The synthesized Iron nanoparticles showed good antimicrobial activity against Gram positive (Bacillus cereus and Staphyloccocusaureus) and Gram negative (Escherichia coli and Klebsiella pneumonia) Bacteria. In this method variation in pressure, temperature and energy did not affect the reaction. Toxic chemicals were not used throughout the experiments. This green synthesis of Iron nanoparticles is environmentally benign, simple and convenient to handle. The study revealed that the MangiferaIndica leaves extract are good source for synthesis of Iron nanoparticles at fast rate.

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