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Synthesis Of Chitosan Encapsulated Iron Oxide Nanoparticles And Its Biomedical Application

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***Abstract**: The Iron oxide nanoparticles were synthesized by co-precipitation method and consequently stabilized by a chitosan coating. The characterization of synthesized nanoparticles was performed by X-ray diffraction (XRD) and Fourier transforms infrared spectroscopy (FTIR). The observed bands at 500-800 cm-1 in the FTIR spectrum indicated the presence of metal-oxygen (Fe-o) bond whereas band at 1646 cm-1 indicated the presence of amino groups (-NH_2) which confirms the CS in the prepared CS-FeO nanoparticles.. The XRD analyses used to prove the synthesized material was magnetite (Fe3O4). The antibacterial activity was assessed by zone of inhibition method against Staphylococcus aureus and Escherichia coli.*

***Keywords:** Chitosan, Iron oxide nanoparticle, biomedical activity,*

1. INTRODUCTION

Chitosan is a polycationic polymer with a large number of primary amines showing useful properties including biocompatibility, biodegradability, adsorption activity and antimicrobial ability (1). Chitosan is usually manufactured from crustacean shells (crabs, shrimps, and crayfishes) either by chemical or microbiological treatments. Biodegradable nanoparticles as effective drug delivery carriers have attracted the scientific community due to their therapeutic benefits without any side effects (2). Iron oxides are chemical compound of iron and oxygen. Biomedical applications are cellular therapy, tissue repair, drug delivery, magnetic response, imaging hypothermia and magneto-fiction (3). Research area applications are biomedicine (4) catalyst (5) sensor (6) etc. In magnetic resonance imaging to provide enhanced contrast at very low concentrations in the nanomolar range for studying tumors.

2. MATERIALS AND METHODS

Preparation of chitosan

Crustacean waste crab shells were collected from Rameswaram seashore. The shells were scraped and washed. Then dried and passed through a 0.3-0.5mm sieve and subjected to demineralization, deproteinization deacetylation and finally the chitosan powder and was obtained. The chitosan was stored at room temperature for further studies.

Synthesis of chitosan coated iron oxide nanoparticles

The synthesized iron oxide nanoparticles were dried and made into a powder. 200 mg chitosan deacetelated with 2-5 ml of formaldehyde gel was formed. And mix under magnetic stirrer for 1 hour. Finally, chitosan coated iron oxide particles were filtered and dried for further analysis.

Zone of inhibition Testing

Antimicrobial activity of the samples was determined by well diffusion method. Two pathogenic bacterial strains namely Escherichia coli and Staphylococcus aureus were examined. The test bacterial strains were inoculated into nutrient broth and incubated at 37^0c for 24 hours. After the incubation clear zone was observed. Inhibition of the bacterial growth was measured in mm.

3. RESULT AND DISCUSSION

XRD Studies

The phase identification and crystalline structure of the nanoparticles was characterized by X- ray diffraction. The X- ray diffraction pattern obtained for iron nanoparticles was synthesized using chitosan showed strong diffraction peaks (111), (110), (250) (fig1)

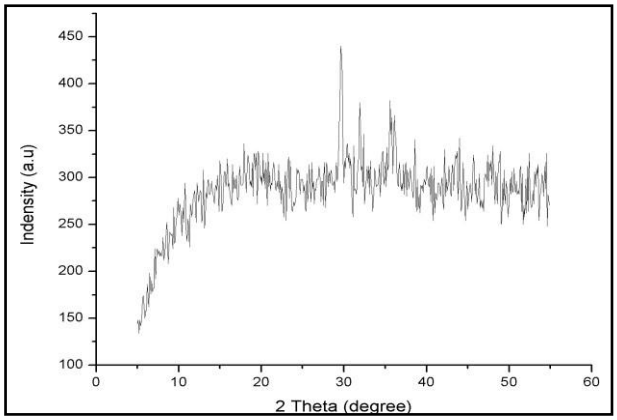

Figure 1: X- Ray Diffractogram of iron- nanoparticles synthesized from Chitosan

Size determination from XRD

Using Debye-Scherers formula the crystalline size for the nanoparticles was calculated.
$D=K\lambda/\beta COS\theta$
Where D is the average particle size in nm , λ is the wave length of X-ray (0.15406nm), β is the full width at half maximum of the diffraction peak, K, is the Scherrer constant with the value of 0.9 to 1 and θ is the Bragg angle.

FTIR Spectra Analysis

The FTIR spectrum of Fe NPs indicated that the NPS manifested absorption peaks at about 3132cm-1, 1631cm-1, 1402cm-1, 1118cm-1, 873cm-1,615cm-1. The peaks near 3132cm-1 corresponded to the stretch vibrations of CH groups. The band at 1631cm-1 corresponded to amide I due to carbonyl stretch in proteins. The peak at 1118cm-1 corresponded to c-o-c ethers. The peak at 873cm-1 belonged to the C-BR stretch of alkyl halides.

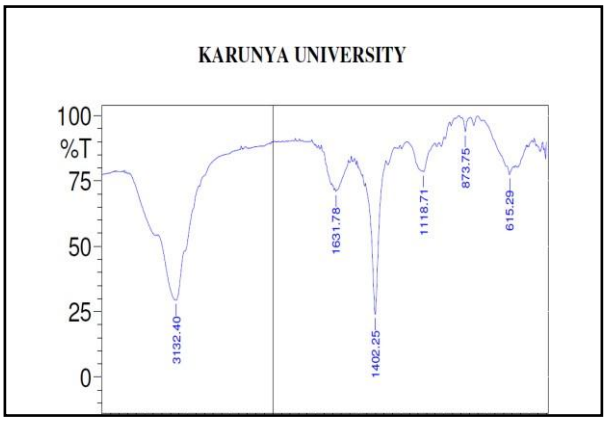

Fig-2: FT-IR spectrum of iron nanoparticles from chitosan

Scanning electron microscopy (SEM) micrograph of the chitosan nanoparticles

The surface morphology of chitosan from the source of crab shells are characterized by Scanning electron microscope. This study indicates a different morphology. SEM image showed (figure 3) spherical and aggregated .This aggregation took place due to the presence of cell component and the surface of the nanoparticles act as the capping agent

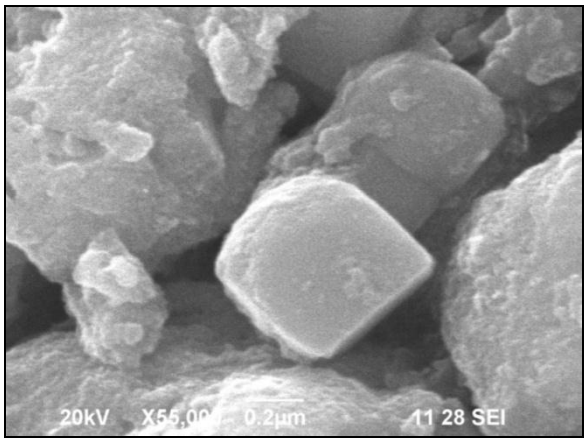

Figure: 3 SEM image of iron nanoparticle synthesized from chitosan

Antibacterial activity

From this examination chitosan particle behave as an antibacterial agent against Escherichia coli and Staphylococcus aureus. When the concentration of standard Gentamycin at 80mcg zone of inhibition for both S.aureus and E.coli were 25mm. similarly Getamysin at 400mcg zone of inhibition for S.auteus and E.coli were same of 12mm whereas when gentamycin at 800 mcg zone of inhibition for S.aureus is 14 mm and for E.coli 13. Comparing this zone of inhibition for standard Gentamycin 80mcg showed the higher activity than the others.

Fig-4: Antimicrobial activity of Iron oxide nanoparticles from chitosan

Table1: Zone of Inhibition

Organism	Zone of inhibition		
	Standard Gentamycin (80mcg)	Standard Gentamycin (400mcg)	Standard Gentamycin (800mcg)
Escherichia coli	25mm	12 mm	13mm
staphylococcus aureus	25mm	12mm	14mm

4. CONCLUSION

In conclusion, the chitosan FeO nanoparticle was synthesized by co-precipitation method. Chitosan coated magnetic iron oxide nanoparticles were synthesized and characterized using XRD, FTIR, SEM and antimicrobial activity. Chitosan nanoparticles and iron loaded chitosan nanoparticles are characterized by FT-IR. The band at 1631cm-1 corresponded to amide I due to carbonyl stretch in proteins. The X-ray diffraction pattern showed the strong diffraction peaks (111), (110), (250) Antimicrobial activity of synthesized iron nanoparticles was studied against Gram positive S.aureus and Gram negative bacteria E.coli and their activity was measured. Zone of inhibition found for iron nanoparticle using Gentamycin 80mcg showed the higher activity than the others. The synthesized chitosan nanoparticles and iron loaded chitosan nanoparticles pretence to have good bactericidal activity.

5. REFERENCES

[1] Kumar. React Funct. Polym., 2000; 46,1-27
[2] Gupta, Ajay kumar and Gupta. Synthesis and surface engineering of iron oxide nanoparticles for biomedical applications, Biomedicals, 2005; 26: 3995-4021.
[3] Gonzalsmarcela and Kannan. Phase transfer of highly monodisperse iron oxide nanocrystals with pluronic F127 for biomedical applications, Journal of magnetism and magnetic materials, 2007; 311:59-62.

[4] Vibinbansal, Pramod kumarsharma. Application of chitosan and chitosan derivative in in drug delivery, Advances in biological research, 2011; 5:28-37, ISSN1992-0067.
[5] V.Mythili and Mysha. Synthesis and characterization of chitosan from crab shells Vs Bacteriological Biomass, World journal of pharmaceutical science, and 1998; 6:1563-1576.
[6] Mihir Herlekar, Siddhivinayak Barve and Rakesh kumar. Plant mediated Green synthesis of Iron Nanoparticles, Journal of Nanoparticles, Article ID 140614 9(1) (2014).