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A COMPARATIVE STUDY OF CHITOSAN-SILVER (I) OXIDE NANOCOMPOSITE AND ITS FABRICATION WITH HERB

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ABSTRACT
The present study reports the synthesis of chitosan-silver (I) oxide nanocomposite and its fabrication with herb *Cynodondactylon*. The synthesised nanocomposites were characterised by UV-Vis, FTIR and FESEM studies. The antibacterial activity of the nanocomposites was determined by Agar well diffusion method. The synthesised composite showed enhanced activity against *E. coli* and *S. aureus.* The FESEM studies proved the embedded silver (I) oxide nanoparticle in nanocomposite and the size of the particles was found to be less than 100 nm.

Keywords: chitosan,*Cynodondactylon*, UV-Vis, FTIR, FESEM, AgarWell diffusion method,*E. coli, S.* aureus

1. INTRODUCTION

The bionanocomposites are composite materials that contain biological origin and particles with atleast one dimension in the range of 1-100 nm **[1]**. The present work involves the synthesis of a novel, ecofriendly, bioactive, antimicrobial bionanocomposite using chitosan, silver (I) oxide nanoparticles and herb *Cynodondactylon*.

Chitin is the second abundant natural polysaccharide after cellulose. It is composed of (1-4) linked 2-acetamido-2-deoxy-β-D-glucose. It is found in exoskeleton of crustaceans, cuticles of insects and cell walls of fungi **[2]**. Chitosan is obtained by deacetylation of chitin **[3]**. It is a linear polymer consisting of (1-4) lined 2-amino-2-deoxy-D-glucose. Chitosan has unique properties such as biocompatibility, biodegradability and antibacterial activity **[4]**. Chitosan has considerable antibacterial activity against both Gram-negative and Gram-positive bacteria **[5]**. Low toxicity, biocompatibility and biodegradability make silver (I) oxide a material of interest for biomedicine and in pro-ecological systems. Different types of nanomaterials like copper, zinc, titanium, magnesium, gold and silver have come up but silver nanoparticles have proved to be more effective as they have good antimicrobial activity against wide variety of bacteria, viruses and other microorganism **[6]**. The botanical name of Bermuda grass is *Cynodondactylon*. In Tamil language, it is known as Arugumpul. *Cynodondactylon* have been used in folk medicine as anti-inflammatory, ant cystitis, anti-hypertensive, anti-viral, anti-hysteria, anti-gonorrheal infections**[7].** Ethanol, methanol and acetone extracts of *Cynodondactylon* showed wide range of antibacterial activity and can be used and administered in the ethnomedical practice **[8]**.

2 EXPERIMENTAL

2.1 Materials

Acetic acid, Polyvinyl Alcohol, SilverNitrate, Glutaraldehyde, Poly Ethylene Glycol and Sodium Hydroxidewere purchased from HiMedia Company and were in analytical grade.

2.2 Synthesis of Chitosan-Silver (I) Oxide Nanocomposite Fabricated with Herb

2.2.1 Synthesisof Chitosan

Chitosan was extracted from crab shells using HCl and NaOH**[9]**. Degree of deacetylation (DDA) of extracted chitosan was determined by UV Spectroscopy method. Chitosan (60% DDA), represented as C_2, in the present study, was selected for the synthesis of nanocomposites.

2.2.2Synthesis of Silver (I) Oxide Nanoparticles

Wet chemical method was employed for the synthesis of silver oxide nanoparticles using silver nitrate, polyethylene glycol and sodium hydroxide **[10]** The synthesised silver (I) oxidenanoparticle is represented by **A.**

2.2.3Collection, Processing and Extraction Of Herb

CynodonDactylon, which is represented as H_2 in this study, was collected in and around Chennai. The leaves were shade dried and then powdered and sieved. 20 grams of herbal powder was suspended 100 ml of methanol and incubated for overnight. The supernatant liquid was filtered using whatman No. 1 filter paper.

2.2.4Synthesis of Chitosan Silver (I) Oxide Nanocomposite

Silver (I) oxide nanoparticle prepared was added into 50 ml of 1% chitosan solution and 50 ml of PVA solution. The obtained solution was stirred for one hour at 60^oC. To this solution 2% glutaraldehydewas added and transferred into glass plates. The synthesised nanocomposite**[11]** is labelled as C_2A

2.2.5Fabrication of CynodonDactylonOver Silver (I) Oxide Nanocomposite

Herb was loaded over chitosan silver (I) oxide nanocomposite film by swelling method. For loading of herbs, the film was allowed to swell in 50 ml of herbal solution for 24 hours at 25^oC.Silver (I) oxide nanocomposite loaded with *Cynodondactylon*herb is labelled as C_2AH_2.

3 CHARACTERIZATION

The synthesisedchitosan-silver (I) oxide nanocomposites (C_2A) and herb loaded chitosan-silver (I) oxide nanocomposites (C_2AH_2)were characterised by UV visible spectrometer of the model SHIMADZU UV 1650 PC and FTIR spectroscopy using IR affinity 1 model of SHIMADZU IR 1650 PC.Morphology of the composites were observed by FESEM through DST nano emission model. The antibacterial activity against *E. coli* and *S. aureus*of the composites was determined by Agar Well diffusion method.

4 RESULTS AND DISCUSSION

4.1 UV Visible Spectral Analysis

UV spectrum of chitosan-silver (I) oxide and chitosan silver (I) oxide nanocomposite fabricated with herb are shown in **Fig.1** and **Fig. 2**

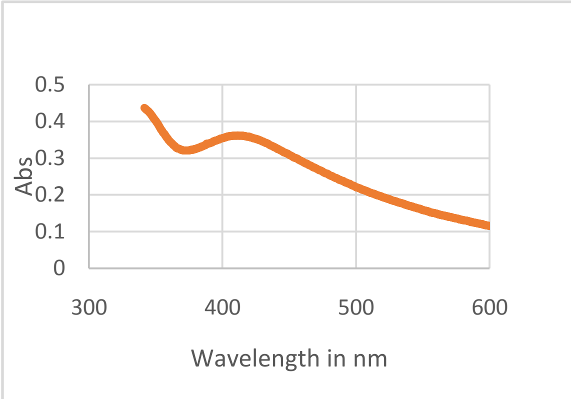

Fig. 1 UV spectrum of C_2A

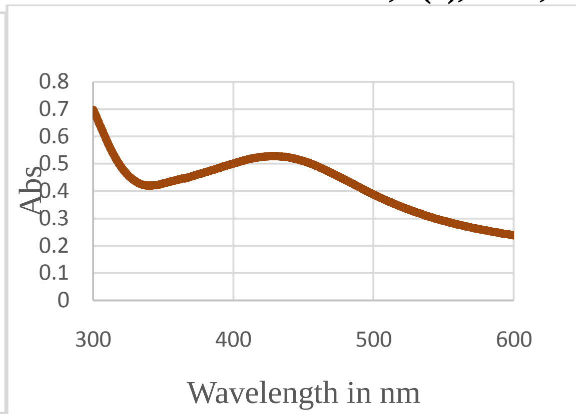

Fig. 2 UV spectrum of C_2AH_2

UV absorption spectrum of C_2A and C_2AH_2 are given in Fig.1 and 2. Nanocomposite C_2A and C_2AH_2 showed absorption maximum at 420 nm due to the excitation of surface plasmon vibrations of silver atoms.

4.2 FTIR Spectrum

FTIR spectrum of C_2A and C_2AH_2 are given in **Fig. 3 and Fig.4**

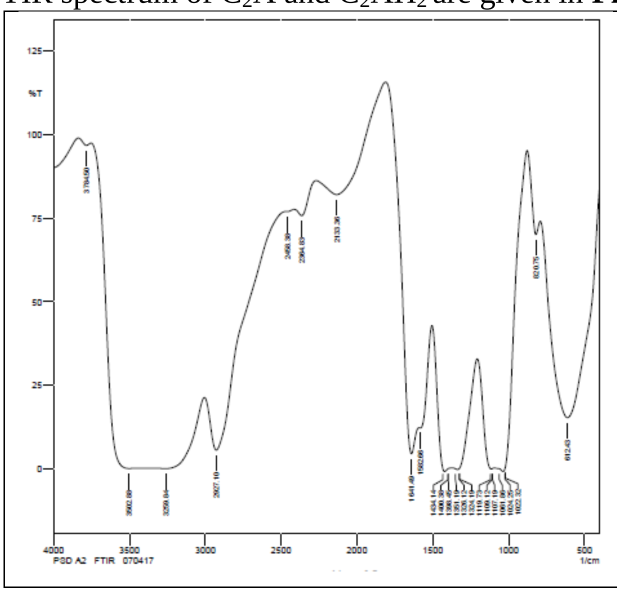

Fig. 3 – FTIR spectrum of C_2A

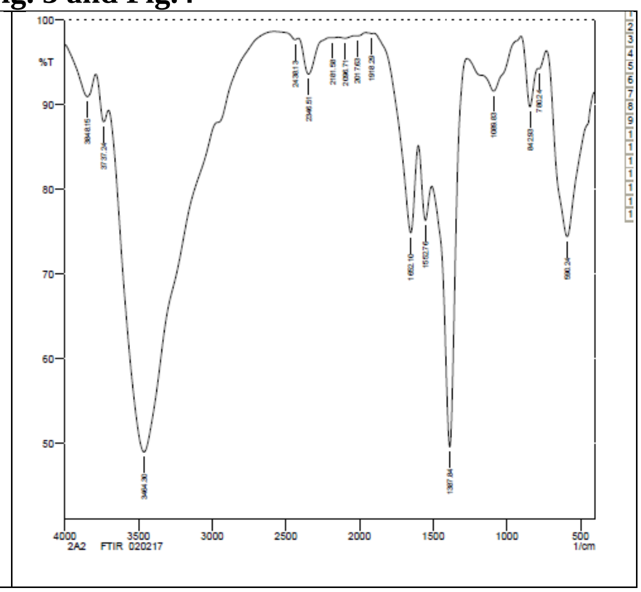

Fig. 4 – FTIR spectrum of C_2AH_2

In C_2A, the bands due to OH and NH stretching vibration shifted to 3259cm^{-1} and 2927 cm^{-1}. The C=O stretching band shifted to 1641 cm^{-1}. A new peak at 612 cm^{-1}indicates the stretching vibration of M-O (metal-oxygen) bond. In C_2AH_2, OH and NH stretching band moved to 3464 cm^{-1}and 2936 cm^{-1}respectively. The C=O stretching band shifted to 1652 cm^{-1}. A new peak at 590 cm^{-1}indicates M-O stretching vibration.

The shifting of the peaks indicated the strong interaction between OH, NH groups and silver (I) oxide. The shifting of the peaks also indicates the fabrication of herbs on chitosan-silver (I) oxide nanocomposite.

4.3 FESEM Analysis

Morphological study of synthesized chitosan silver (I) oxide nanocomposite(C_2A) and chitosan silver (I) oxide nanocomposite fabricated with herb(C_2AH_2)were carried out with field emission scanning electron microscope (FESEM). **Fig. 5 and Fig. 6**shows the SEM images of the composites C_2A and C_2AH_2respectively. It was observed that the size of the silver (I) oxide nanoparticles was less than 100 nm. SEM image of C_2AH_2 (**Fig. 6**) clearly shows the fabrication of herb into C_2A.

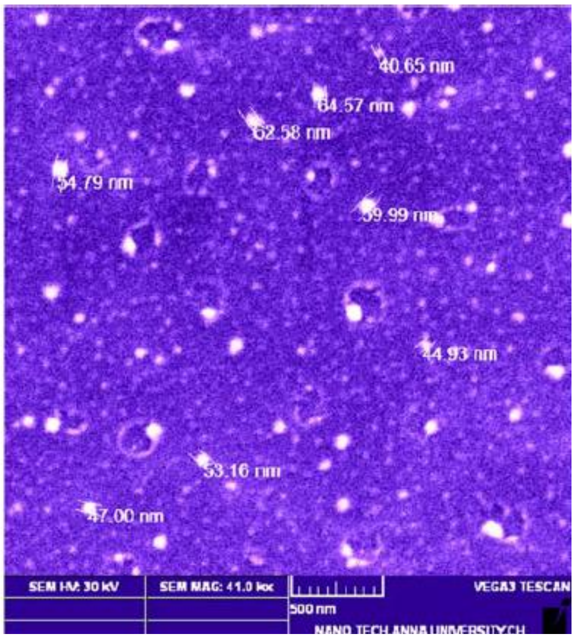

Fig. 5 – SEM image of C_2A

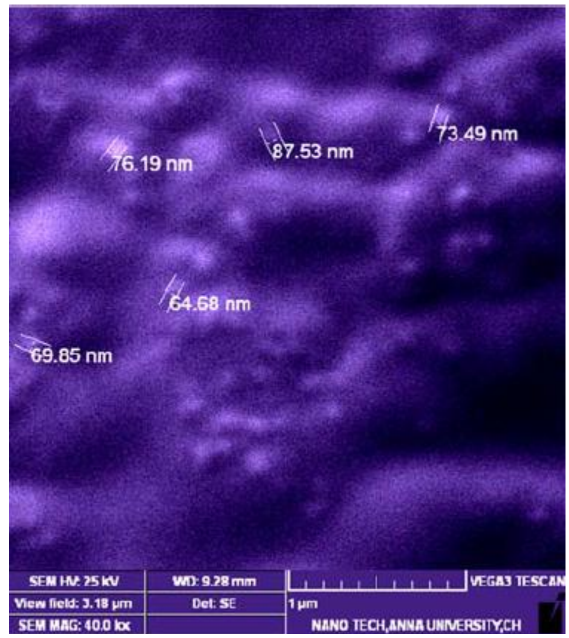

Fig. 6 – SEM image of C_2AH_2

4.4 Antibacterial activity

The antibacterial activity of chitosan silver (I) oxide nanocomposite(C_2A) and chitosan silver (I) oxide nanocomposite fabricated with herb(C_2AH_2) wasdetermined by Agar Well diffusion method. The antibacterial activity of the nanocomposites was tested against *E. coli* and *S. aureus*. The antibacterial activity was measured based on the diameter of zone of inhibition in mm and the values are given in **Table 1**.It was observed that fabrication of herb into chitosan silver (I) oxide nanocomposite influences the antibacterial efficiency and showed enormous growth inhibition against *E. coli* and *S. aureus*. Hence, to improve the therapeutic efficacy of chitosan silver (I) oxide nanocomposite as antimicrobial agent, herb was fabricated into chitosan silver (I) oxide nanocomposite. The enhanced activity is due to the synergistic effect of chitosan, silver (I) oxide nanoparticles and herb.

Table 1 – Antibacterial activity of C_2A and C_2AH_2

S. No	Samples	Zone of inhibition (mm)	
		E. coli	***S. aureus***
1	Amoxicillin (Std)	10	12
	C_2A	13	11
	C_2AH_2	26	21

5 CONCLUSION

In the current work chitosan silver (I) oxide nanocomposite was synthesised (C_2A). To improve the antibacterial activity of the nanocomposite, *Cynodon Dactylon*was fabricated into the nanocomposite (C_2AH_2). The synthesised nanocomposites C_2A, C_2AH_2 were characterised by UV, FTIR and SEM studies. SEM studies prove the presence of silver (I) oxide nanoparticles in the chitosan matrix. The size of the silver (I) oxide nanoparticles in C_2A and C_2AH_2 was found to be 50-100 nm. Antibacterial activity of these nanocomposites was determined by Agar well diffusion method. The antibacterial activity was enhanced by adding *Cynodondactylon*to chitosan silver (I) oxide nanocomposite

REFERENCES

1. Ahmed, M.B; Shemeli, K; Darroudi, M.; Yunus, W.; Ibrahim, N.A.; *Am.J. Appl. Sci*. **2009**, 6, 2030-2035
2. Singh D.K.; Ray, A.R.; *J. Macromol Sci Rev Macromol Chem Phys,* **2000**, C40-69
3. Jana, S.; Saha, A.; Nayak, A.K.; Sen, K.K.; Basu, S.K.; B: *Biointerfaces*, **2013**, 105 (1), 303-309
4. Kwong, T.; et. al.; *Journal of Applied Polymer Science*, **2006**, 102(2), 1787-1993
5. Chung, Y.C.; Su, Y.P.; Chen, C.C.; Jia, G.; Wang, H.L.; Wu, J.C.W.; *Acta Pharm. Sin*, **2004**, 25, 932-936
6. Shipra Tripathi; Mehrotra, G.K.; Dutta, P.K. *Bull. Mater. Sci*, Vol. 34, No. 1, February 2011, pp 29-35
7. Bogutska, K.I., Yu, P.; Skylyarov, Yu, I.; *Prylutsky Ukronica Bioorganica Acta* 1, **2013**, 9-16
8. Kanimozhi, D.; Rathabai, V.; *International Journal of Research in Pharmacy and Science*, April-June **2012**, 2(2), 34-38
9. Shanthi, P.; Jayashree Ghosh, Kothai, S.; *Proceedings of National Conference on recent advances in Applied Sciences* Feb 5, 6 – **2015,** ISBN: 978-81-923944-2-3.
10. Ng Law Yongm Akil Ahmad; Abdul Wahab Mohammed.*International Journal of Scientific and Engineering Research,*Volume 4, Issue 5, May-2013.
11. Kanikireddy Vimala; Yallapu Murali Mohan; Kokkarachedu Varaprasad; Nagireddy Narayana Reddy; Sakey Ravindra; Sudhakar Naidu Neppalli, Konduru Mohana Raju – *Journal of Biomedicals and Nanobiotechnology*, 2, 55-64 (2011).