

## Supporting information

# Fabrication of Antibacterial Silver Nanoparticle – Sodium Alginate-Chitosan Composite Films

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## MATERIALS AND METHODS

### Chemicals and Growth media

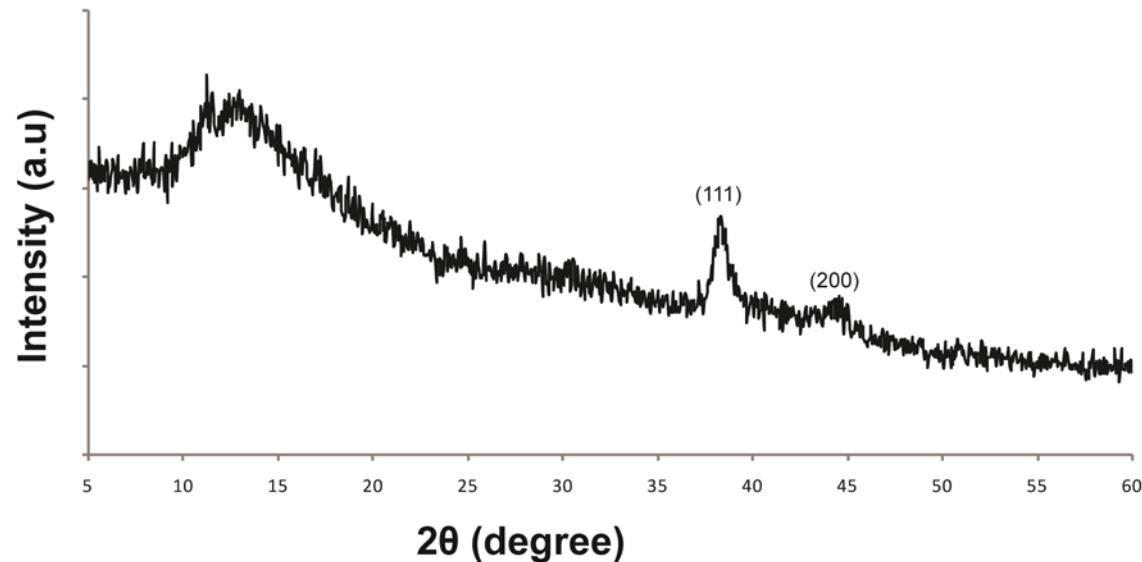
Chitosan (high MW, >75% deacetylated) was obtained from Sigma Aldrich Chemical Pvt. Ltd., Kolkata, India and alginate from Loba Chemie Pvt. Ltd., Mumbai, India. Silver nitrate, acetic acid (glacial, 99–100%) and acetone were purchased from Merck India Ltd, Mumbai, India. Luria-Bertani Broth (LB), Nutrient broth (NB) and brain-heart infusion (BHI) growth media were purchased from HiMedia, Mumbai, India. For preparing solid media, the nutrient media was supplemented with 1.5 % bacteriological agar (Himedia Laboratories Ltd., Mumbai) as solidifying agent.

### Bactericidal activity of the composite

The antibacterial activity of Alg-Ag NPs was tested against *E. coli* and *B. cereus* MTCC 1305 as representative strains of Gram negative and Gram positive bacteria respectively by well diffusion method. The suspensions of bacterial cultures in the range of  $10^5$ -  $10^6$  cfu ml<sup>-1</sup> were made and streaked over the surface of agar plates to obtain uniform growth. After the plates were dried for

5 min, 4 distinct wells were punctured into the agar plates and filled with Alg-Ag NPs solution and alginate solution as control. The zones of inhibition were observed after incubation at 37°C overnight.

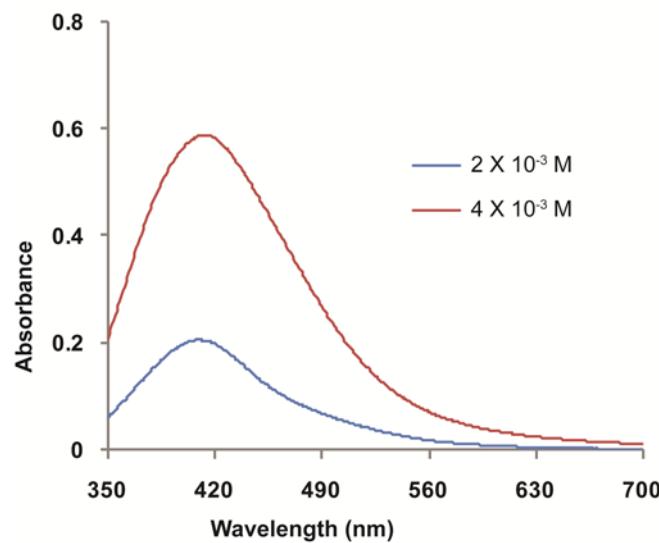
## RESULTS



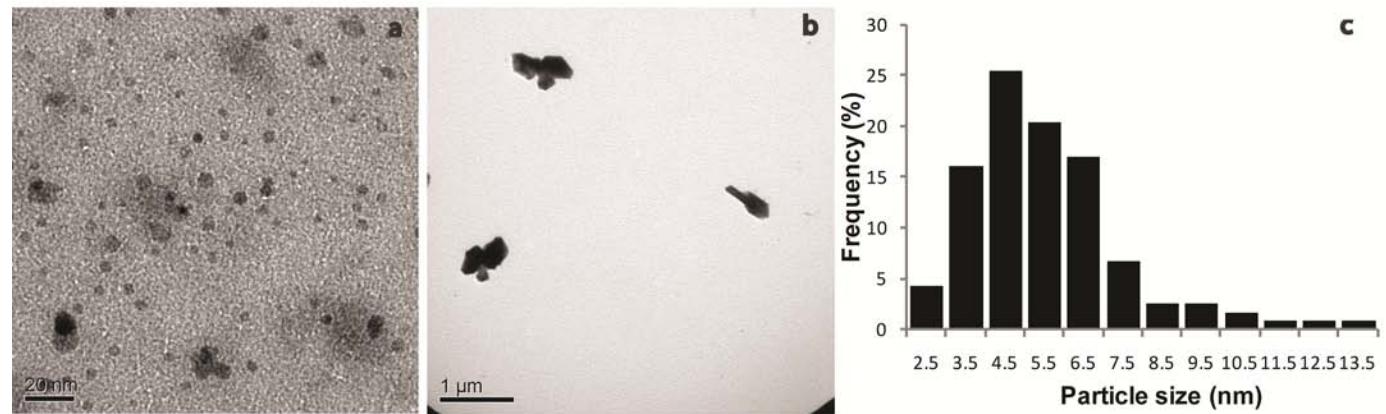
**Figure S1.** XRD pattern of Alg-Ag NPs showed peaks at 38.2° and 44.3° corresponding to the (111) and (200) planes of the cubic structure of metallic Ag. Absence of peaks at 32.8°, 46.2° and 54.6° corresponding to  $\text{Ag}_2\text{O}^{1-2}$  indicates that  $\text{Ag}_2\text{O}$  does not form during the synthesis.

Ag NPs were prepared at higher  $\text{Ag NO}_3$  concentrations ( $2 \times 10^{-3}$  M and  $4 \times 10^{-3}$  M) keeping alginate concentration and temperature as 0.2 % and 90 °C, respectively. UV-Vis spectra measurements (Figure S2) showed broad peaks at ~409 nm and ~413 nm for NPs prepared using  $2 \times 10^{-3}$  M and  $4 \times 10^{-3}$  M  $\text{Ag NO}_3$  concentration, respectively indicating wide distribution of NPs. This was confirmed by TEM measurements. For NPs prepared using  $2 \times 10^{-3}$  M  $\text{Ag NO}_3$  concentration, particles of various shapes were formed (Figure S3a). The particle size distribution was calculated by measuring diameters of spherical particles. The average size was calculated to be  $5.65 \pm 2.4$  nm (Figure S3c). In case of NPs synthesized using  $4 \times 10^{-3}$  M  $\text{Ag}$

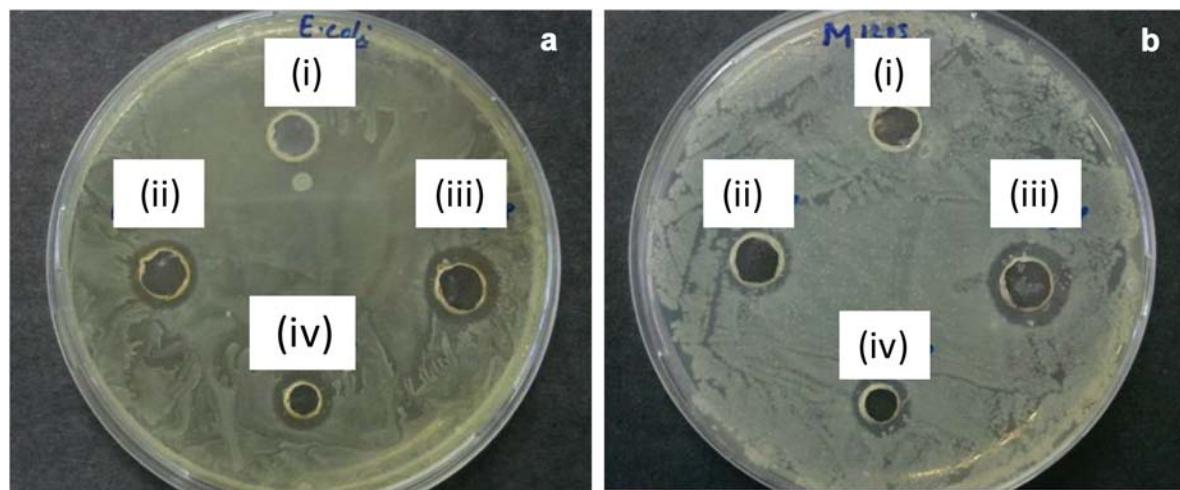
$\text{NO}_3$ , TEM images showed that the particles of various irregular morphologies were formed (Figure S3b). Most of the particles were found to be aggregated.



**Figure S2.** UV-vis spectra of Ag NPs prepared using 5 times and 10 times initial  $\text{Ag NO}_3$  concentrations (i.e.  $2 \times 10^{-3}$  M and  $4 \times 10^{-3}$  M respectively) and 0.2 % alginate at 90 °C.



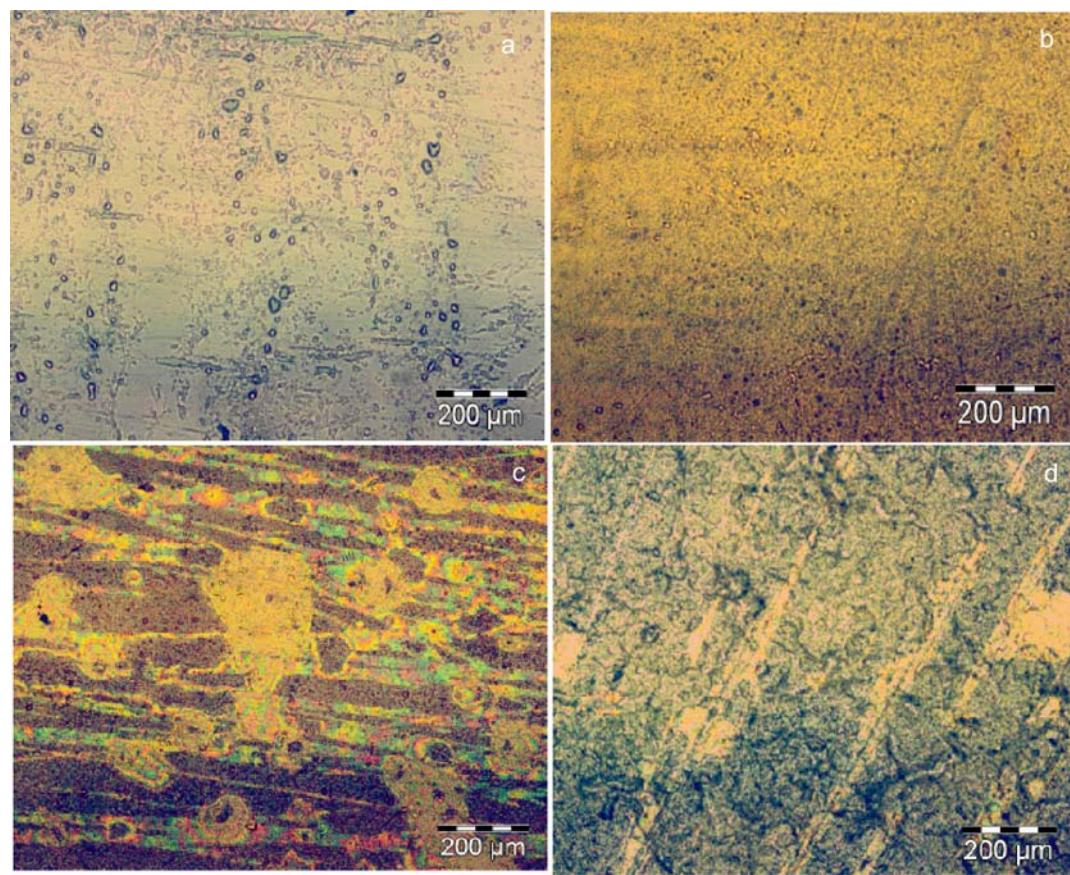
**Figure S3.** TEM images of NPs synthesized using (a)  $2 \times 10^{-3}$  M and (b)  $4 \times 10^{-3}$  M of  $\text{Ag NO}_3$ , (c) Particle size distribution of NPs prepared using  $2 \times 10^{-3}$  M  $\text{Ag NO}_3$ .



**Figure S4.** Photographs of antimicrobial test results of (i) alginate and (ii-iv) Alg-Ag NPs against (a) *E. coli* and (b) *B. cereus* MTCC 1305 strains.



**Figure S5.** Photograph of different (C) chitosan, (1) 1:1, (2) 2:1 and (3) 4:1 films



**Figure S6.** Optical micrographs of (a) chitosan film (b) 1:1, (c) 2:1 and (d) 4:1 blended films.

## REFERENCES

1. S. Pal and G. De, *Materials Research Bulletin*, 2009, **44**, 355-359.
2. Y. Xiao, Y.S. Li and G. H. Swihart, *Talanta*, 2002, **58**, 755-760.