Electronic Supplementary Material (ESI) for RSC Advances.


# Supplementary information

## Extracellular probiotic lipase capped silver nanoparticles as highly efficient broad spectrum antimicrobial agents

Imran Khan[1‡], Nivetha Sivasankaran[1‡], Ravikiran Nagarjuna[2], Ramakrishnan Ganesan[2*] and Jayati Ray Dutta[1*]

*[1]Department of Biological Sciences, BITS Pilani, Hyderabad Campus, Jawahar Nagar, Kapra Mandal, Hyderabad – 500078, Telangana, India. Tel.: +91 40 6630 3542;*

*E-mail: jayati@hyderabad.bits-pilani.ac.in*

*[2]Department of Chemistry, BITS Pilani, Hyderabad Campus, Jawahar Nagar, Kapra Mandal, Hyderabad – 500078, Telangana, India. Tel: +91 40 6630 3602;*

*E-mail: ram.ganesan@hyderabad.bits-pilani.ac.in*

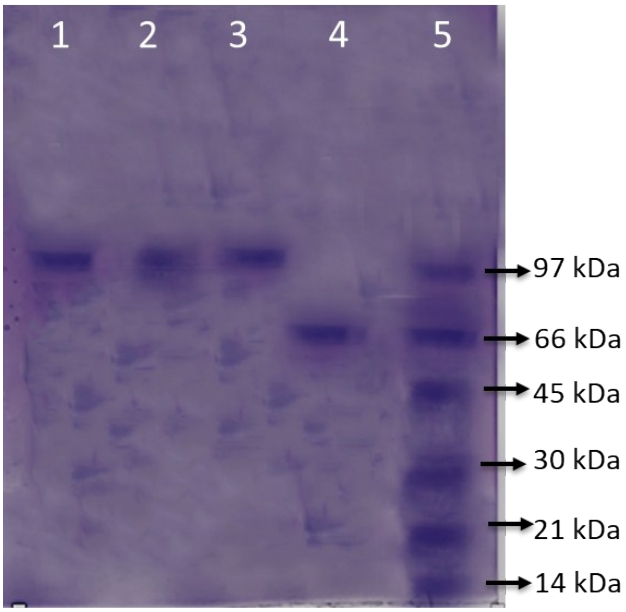


**Figure S1.** SDS-PAGE analyses of (1) 100, (2) 50 and (3) 25 µg/mL lipase-capped Ag NPs synthesized from 1 mM $AgNO_3$ solution. The SDS-PAGE analyses of (4) pristine lipase and (5) 100 kDa protein ladder (Sigma Aldrich) are given for comparison.

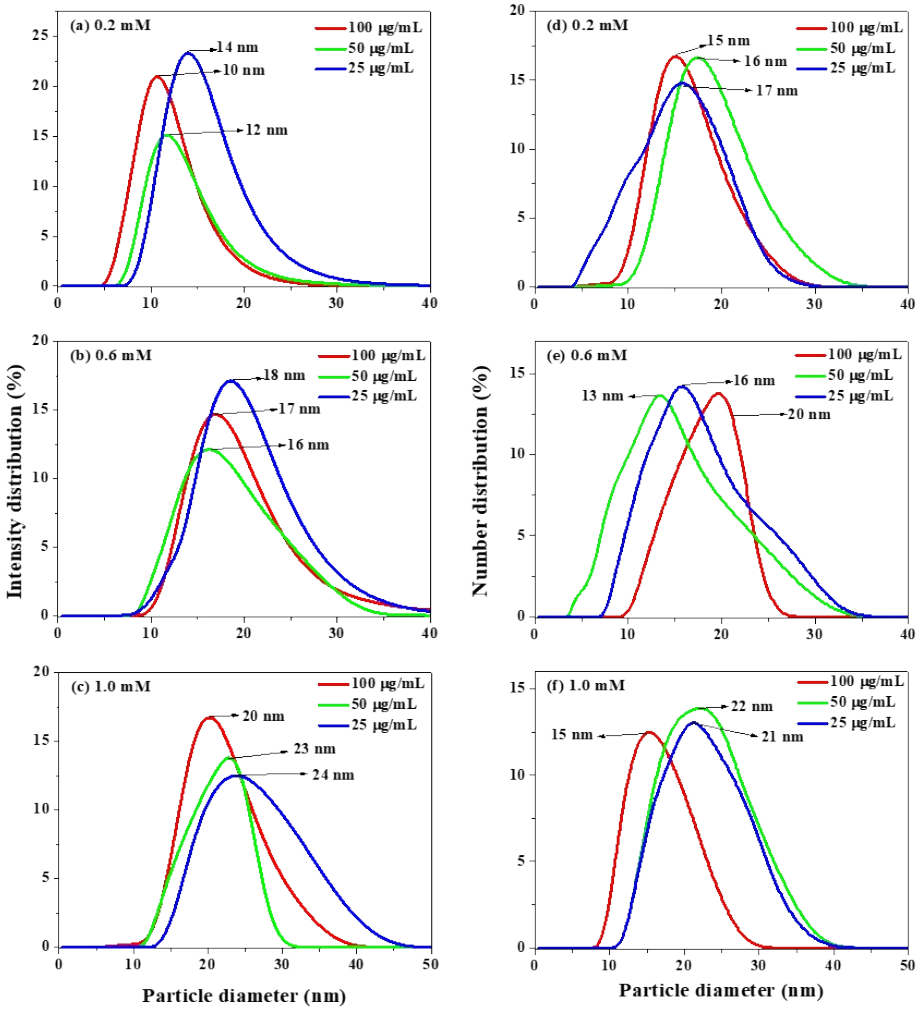


**Figure S2.** DLS measurements showing intensity (a-c) and number (d-f) distribution of Ag NPs synthesized from 0.2, 0.6 and 1.0 mM $AgNO_3$ solutions with varying amount of lipase capping agent.

**Table S1.** Comparative MIC values of Ag NPs against various microbial strains.

| **Microbes** | **Initial Concentration (CFU/mL)** | **MIC of Ag NPs** | **Reference** |
|---|---|---|---|
| *Escherichia coli*<br>*Staphylococcus aureus*<br>*Yeast* | $10^7$ | 0.56 ng/mL<br>5.6 ng/mL<br>2.24 ng/mL | 31 |
| *Bacillus subtilis*<br>*Staphylococcus aureus*<br>*Pseudomonas aeruginosa*<br>*Escherichia coli* | N/A | 6.8 µg/mL<br>5.1 µg/mL<br>1.70 µg/mL<br>3.4 µg/mL | 35 |
| *Escherichia coli J53*<br>*Escherichia J53pMG101*<br>*Salmonella sp.*<br>*Staphylococcus aureus* | 2.5 to 4 x $10^5$ | 3.7 µg/mL<br>4.0 µg/mL<br>3.0 µg/mL<br>4.0 µg/mL | 36 |
| *Pseudomonas aeruginosa* | $10^6$ | 2 µg/mL | 37 |

| | | | |
|---|---|---|---|
| *Escherichia coli*<br>*Staphylococcus aureus* | $10^5$ | 6.25 µg/mL<br>7.5 µg/mL | 38 |
| *Escherichia faecalis* | $10^8$ | 5 mg/mL | 39 |
| *Escherichia coli MTCC 443*<br>*Escherichia coli MTCC 739*<br>*Bacillus subtilis MTCC 441*<br>*Staphylococcus aureus NCIM 5021* | $10^5$ | 20 µg/mL<br>60 µg/mL<br>30 µg/mL<br>70 µg/mL | 40 |
| *Escherichia coli 116S, J53*<br>*Escherichia coli J53pMG101* | $10^8$ | 0.216 ng/mL<br>8.64 ng/mL | 41 |
| *Escherichia coli* | $5.0 \times 10^6$ | 5 µg/mL | 42 |
| *BCG*<br>*Escherichia coli* | $10^5$ | 5 µg/mL<br>10 µg/mL | 43 |
| *Escherichia coli*<br>*Acinetobacter baumanii*<br>*Pseudomonas aeruginosa*<br>*Bacillus subtilis*<br>*Mycobacterium smegmatis*<br>*Mycobacterium bovis*<br>*Staphylococcus aureus* | $10^5$ | 0.5 µg/mL<br>0.4 µg/mL<br>0.4 µg/mL<br>1.7 µg/mL<br>0.5 µg/mL<br>1.1 µg/mL<br>0.7 µg/mL | 44 |
| *Escherichia coli* | $10^8$ | 1.35 ng/mL | 45 |
| *Salmonella enterica* | $10^5$ | 9-14 µg/mL | 46 |
| *Escherichia coli*<br>*Staphylococcus aureus*<br>*Bacillus anthracis*<br>*Candida albicans* | $10^5$ | 1.7 µg/mL<br>1.9 µg/mL<br>3.0 µg/mL<br>19 µg/mL | 47 |
| *Staphylococcus aureus*<br>*Pseudomonas aeruginosa*<br>*Salmonella enterica*<br>*Escherichia coli* | $10^5$ | 4.7 µg/mL<br>2.3 µg/mL<br>2.3 µg/mL<br>1.2 µg/mL | 48 |
| *Escherichia Coli*<br>*Salmonella typhimurium* | $10^5$ | 4.0 µg/mL<br>6.0 µg/mL | 49 |
| *Bacillus cereus*<br>*Bacillus subtilis*<br>*Staphylococcus aureus*<br>*Micrococcus luteus*<br>*Enterobacter cloacae*<br>*Serratia marcescens*<br>*Shigella dysentery* | $10^8$ | 60 µg/mL<br>58 µg/mL<br>59 µg/mL<br>60 µg/mL<br>49 µg/mL<br>50 µg/mL<br>48 µg/mL | 50 |
| *Escherichia coli MTCC 443*<br>*Bacillus subtilis MTCC 441*<br>*Escherichia coli MTCC 739*<br>*Staphylococcus aureus NCIM 5021* | $10^5$ | 20 µg/mL<br>60 µg/mL<br>30 µg/mL<br>70 µg/mL | 51 |
| *Escherichia coli*<br>*Staphylococcus aureus* | $10^5$ | 16.9 µg/mL<br>8.45 µg/mL | 52 |
| *Pseudomonas putida*<br>*Staphylococcus aureus*<br>*Aspergillus niger* | $10^5$ | 1.08 ng/mL<br>1.08 ng/mL<br>1.62 ng/mL | This work |

The literature reporting the MIC values in the ng/mL are highlighted in red color.