# Supporting Information

## Functional silver nanoparticles as broad-spectrum antimicrobial agents

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## S1. Characterization of Ag NPs, 5NI-Ag NPs, Try-Ag NPs

To observe the crystalline structure of Ag NPs, 5NI-Ag NPs, and Try-Ag NPs, XRD analysis was carried out with sweep stroke angle of 5-80º, scanning speed of 0.02º per step. According to Figure S1 and XRD standard spectra, 38.18º, 44.1º, 64.5º and 77.45º was correspond to the characteristic absorption of 111, 200, 220 and 311 crystal planes of Ag NPs respectively, which confirm that the crystalline structure of Ag NPs, 5NI-Ag NPs, and Try-Ag NPs were face-centered cubic lattice.[1]

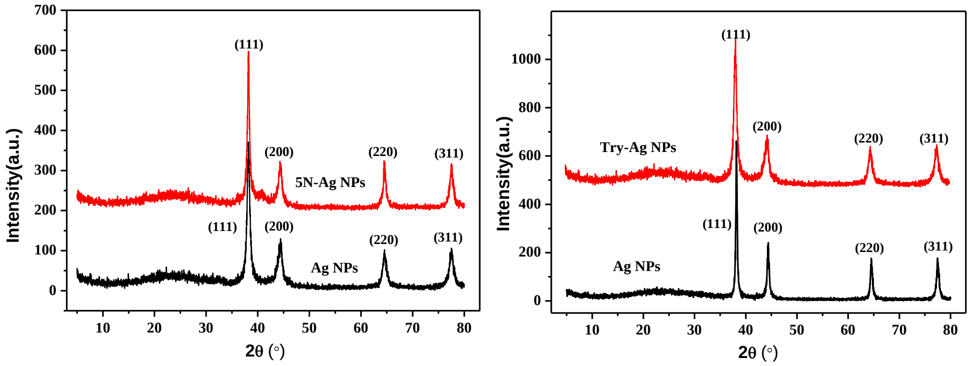


**Figure S1.** XRD spectra of Ag NPs, 5NI-Ag NPs, and Try-Ag NPs.

The hydrodynamic sizes of 5NI-Ag NPs and Try-Ag NPs by Zeta-DLS analysis are about 200 nm (Figure S2), which are different from the TEM analysis (the size is about 10-20 nm). And the difference of the sizes between TEM and DLS could be ascribed to the fact that, for DLS, the hydration radius was calculated, while for TEM, the nanoparticles were dried before observation.[2]

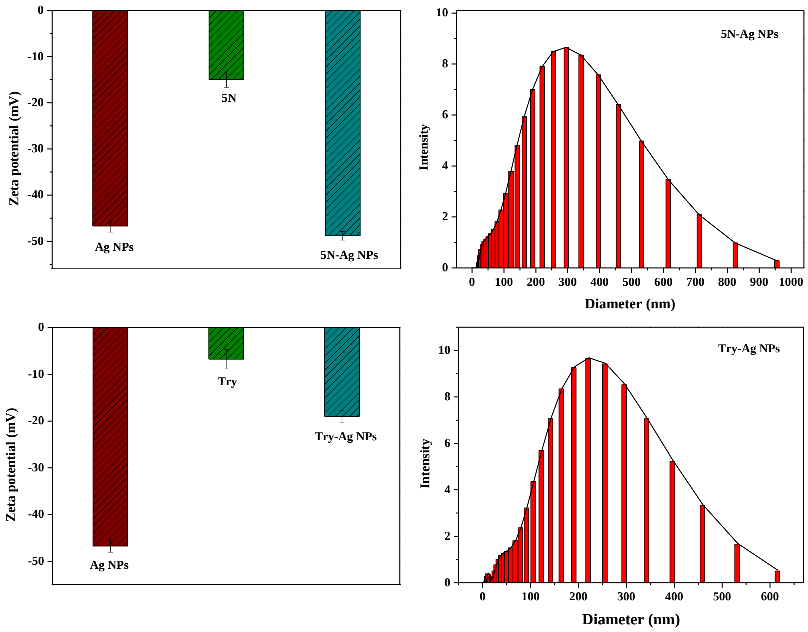


**Figure S2.** Zeta-DLS analysis of Ag NPs, 5NI-Ag NPs, and Try-Ag NPs.

## S2. Growth curve of *E. coli* and *S. aureus*

It can be seen from **Figure S3** that $OD_{600}$ is positively correlated with the number of bacteria, the curve show the adjustment period, logarithmic period, and stationary period of bacterial growth, which suggest that the growth and reproduce of bacterial are normal. The growth curve of *E. coli* and *S. aureus* in **Figure S4** show that stabilizer Tween-80 didn't reflect the growth of bacteria, 5NI-Ag NPs with the concentration of 14 μg/mL, 26 μg/mL could completely inhibit the growth of *E. coli* and *S. aureus* respectively. While uncapped Ag NPs and indole capped Ag NPs with 200 μg/mL couldn't completely inhibit the growth of bacteria.

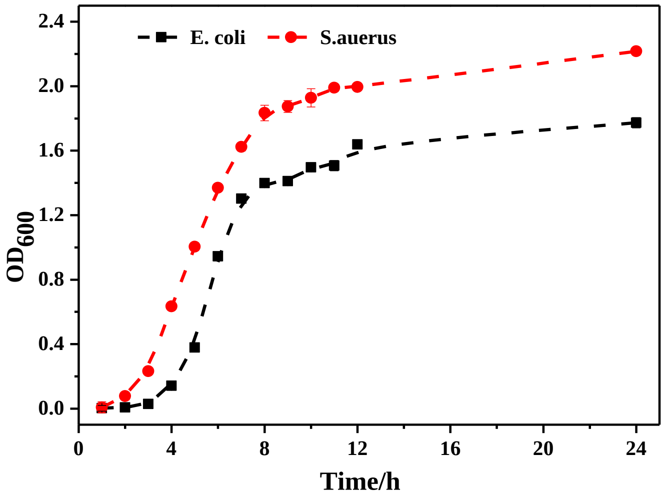


**Figure S3.** Growth curve of *E. coli* and *S. aureus.*

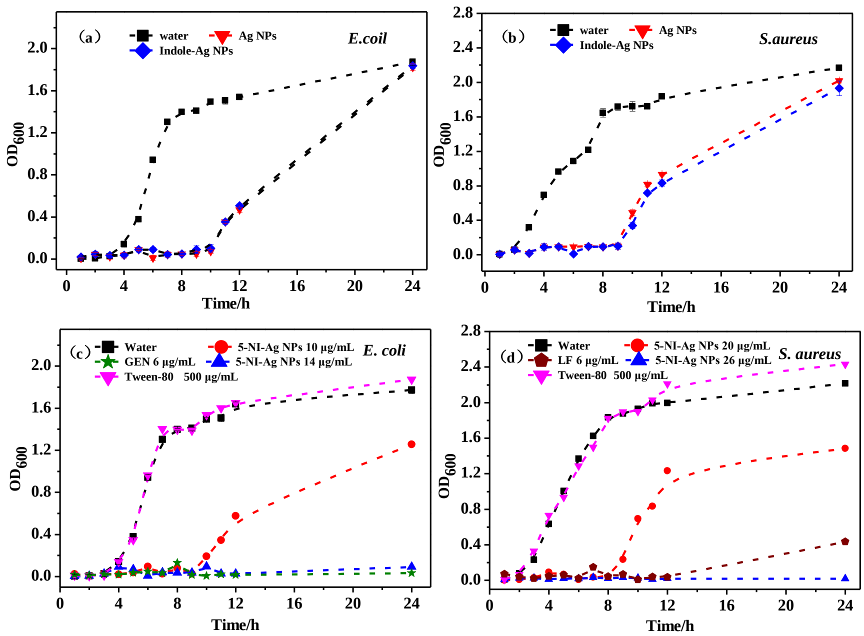


**Figure S4.** Growth curves of *E. coli* and *S. aureus* in different environments

## S3. Antibacterial activity

It is known that silver can damage the bacteria cell walls, therefore Ag NPs has antibacterial activities against viruses.[3] Firstly, the effects of different concentrations of Ag NPs on the growth of *E.coli* and *S. aureus* were investigated. Experiment results in **Figure S5** showed that the MIC of Ag NPs against *E.coli* and *S. aureus* was 200 µg/mL and 260 µg/mL respectively.

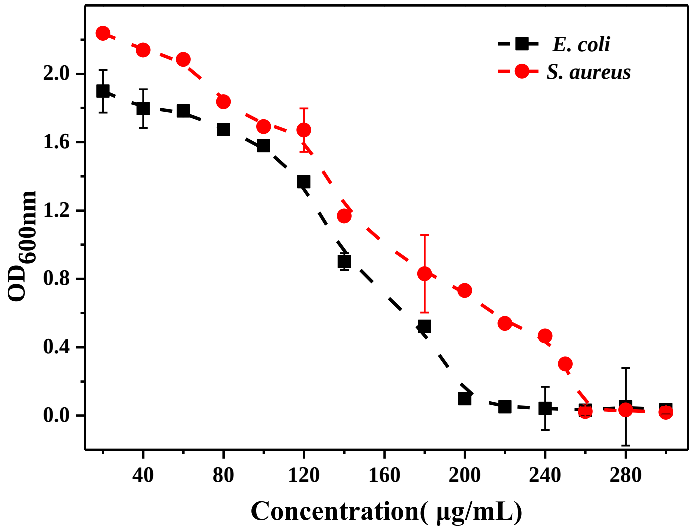


**Figure S5**. Effects of different concentrations of Ag NPs on the growth of *E.coli* and *S.aureus.*

To study the antibacterial activity of IDs-Ag NPs, the inhibition zone method was used to investigate if the indole derivatives-functionalized silver nanoparticles have antibacterial activity. From **Figure S6**, results showed that nitro-substituted indole capped Ag NPs have some extent antibacterial activity and 5NI-Ag NPs exhibit good antibacterial activity against both *E.coli* and *S. aureus*. Subsequently, the antibacterial activity of 5NI, 5NI-Ag NPs, Ag NPs, and Try NPs were also inspected by inhibition zone method in **Figure S7 and Figure S8.**

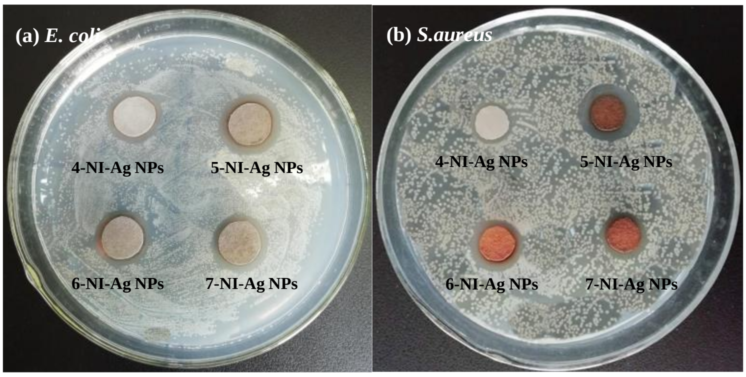


**Figure S6**. Antibacterial activity of *n*-NI-Ag NPs against *E. coli and S. aureus*.

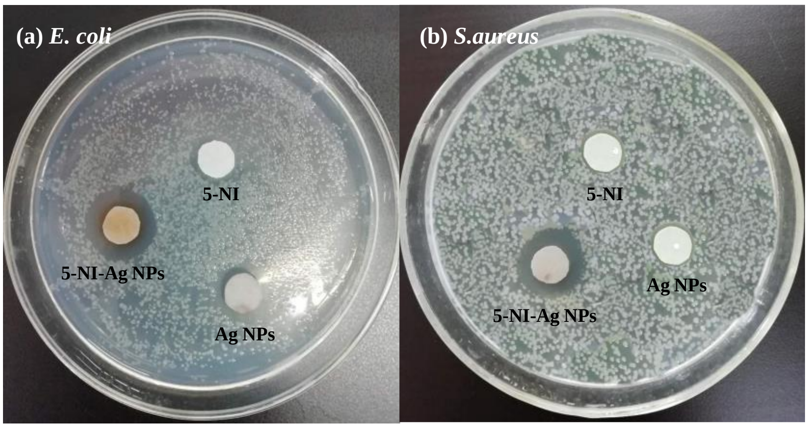


**Figure S7.** Antibacterial activity of 5-NI, 5NI -Ag NPs and Ag NPs against *E. coli* and *S. aureus.*

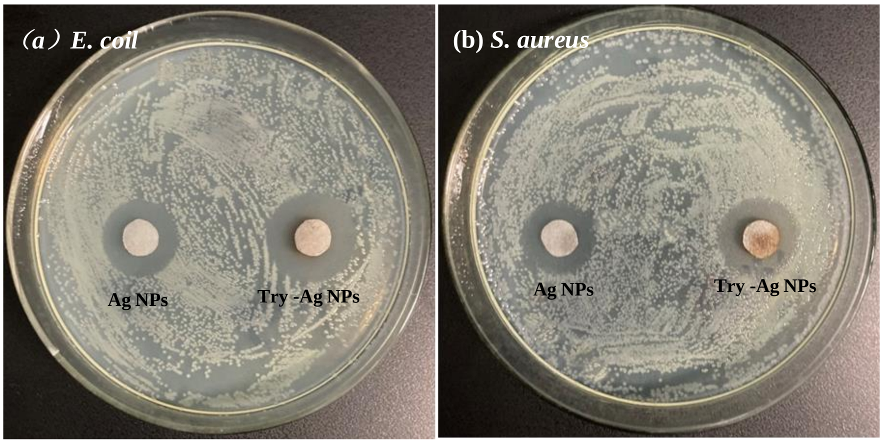


**Figure S8.** Antibacterial activity of Try-Ag NPs and Ag NPs against *E. coli* and *S. aureus.*

The effects of different concentrations of Try-Ag NPs on the growth of *E. coli* and *S. aureus* (8 h) were investigated by the method of constant dilution. It can be clearly seen in Figure S9 that 3 μg/mL and 4 μg/mL of Try-Ag NPs can keep the culture medium of *E. coli* and *S. aureus* clear within 8 h, which indicate that the growth of *E. coli* and *S. aureus* were inhibited.

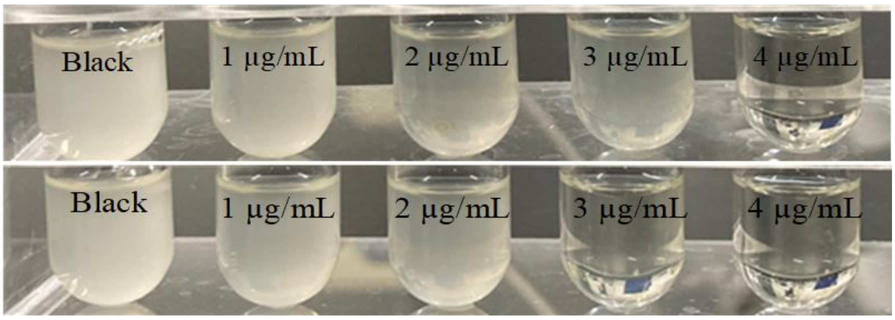


**Figure S9.** The growth state of *S. aureus* and *E. coli* in different concentrations of Try-Ag NPs (8 h)

## S4. References


(1) Gevorgyan, S.; Schubert, R.; Yeranosyan, M.; Gabrielyan, L.; Trchounian, A.; Lorenzen, K.; Trchounian, K. Antibacterial Activity of Royal Jelly-Mediated Green Synthesized Silver Nanoparticles. *AMB Express* **2021**, *11*, 51−58.

(2) Guo, Q.; Zhao, Y.; Dai, X.; Zhang, T.; Yu, Y.; Zhang, X.; Li, C. Functional Silver Nanocomposites as Broad-Spectrum Antimicrobial and Biofilm-Disrupting Agents. *ACS Appl. Mater. Interfaces* **2017**, *9*, 16834−16847.

(3) Mei, L.; Lu, Z. T.; Zhang, X. G.; Li, C. X.; Jia, Y. X. Polymer-Ag Nanocomposites with Enhanced Antimicrobial Activity against Bacterial Infection. *ACS Appl. Mater. Interfaces* **2014**, *6*, 15813−15821.