A microfluidic colorimetric biosensor for rapid detection of *Escherichia coli* O157:H7 based on gold nanoparticle aggregation and smart phone

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Abstract

Simple and rapid screening of foodborne pathogenic bacteria in foods is a key to ensure food safety. This study intended to develop a simple, low-cost and rapid biosensor for the detection of foodborne bacteria using gold nanoparticles (AuNPs) aggregation for indicating different concentration of the target and smart phone for monitoring the color change of the AuNPs, and use *Escherichia coli* O157:H7 as research model for concept proof and performance evaluation. The proposed colorimetric biosensor exhibited a good specificity and sensitivity for the detection of *E. coli* O157:H7 with a lower detection limit of 5 x 10^1 CFU/mL, which was about 100 times more sensitive than the conventional HRP-based ELISA method. The proposed gold nanoparticle aggregation method was demonstrated to effectively improve the sensitivity, and could be used with other H_2O_2 testing methods for bacteria detection.

Principle

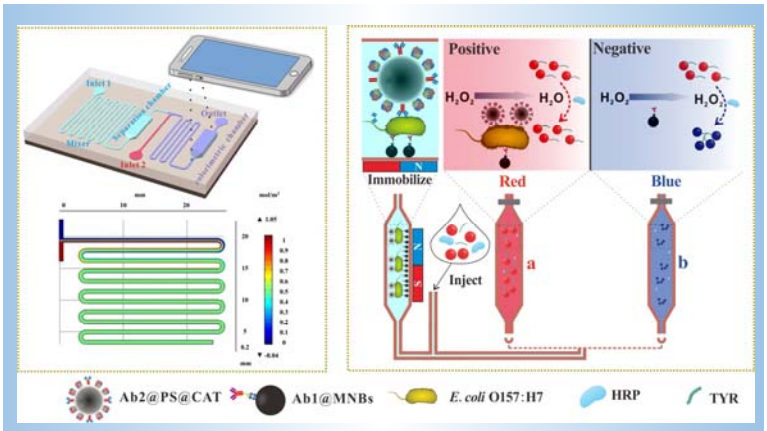

Fig. 1. The principle of the microfluidic colorimetric biosensor for rapid detection of *Escherichia coli* O157:H7 based on gold nanoparticle aggregation and smart phone.

Results and Discussion

❑Proof of the concept

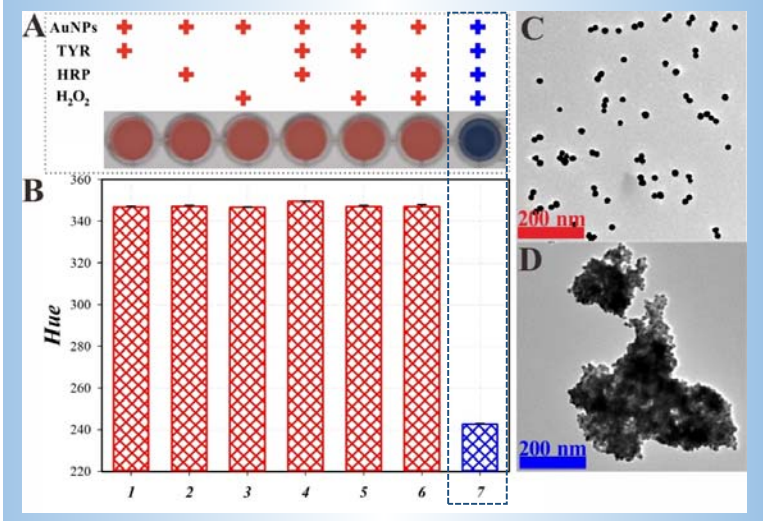

Fig. 2. (A) Feasibility of the HRP+H_2O_2+TYR guided aggregation of AuNPs; (B) The APP analysis results of hue; (C) TEM image of the AuNPs in the absence of H_2O_2; and (D) TEM image of the AuNPs in the presence of H_2O_2.

❑TEM images of the PS, MNBs and complexes

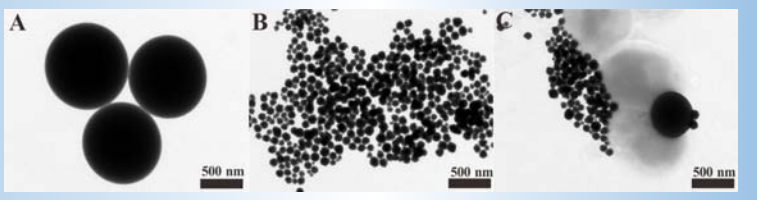

Fig. 3. (A) TEM image of the PS (B) TEM image of the MNBs (C) TEM image of the PS and MNBs incubated with *E.coli* O157:H7.

❑Optimizations of the experimental parameters

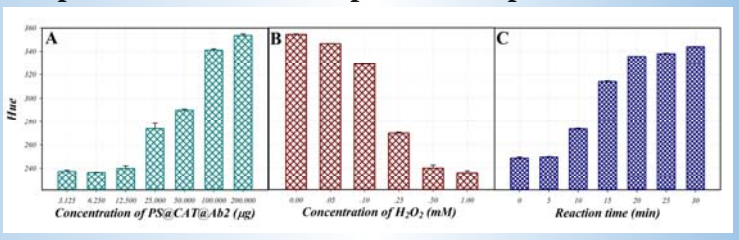

Fig. 4. Optimization of the conditions for the biosensor. the concentrations of PS@CAT@Ab2(A) and H_2O_2 (B), and reaction time (C).

❑Sensitivity and specificity of the microfluidic biosensor

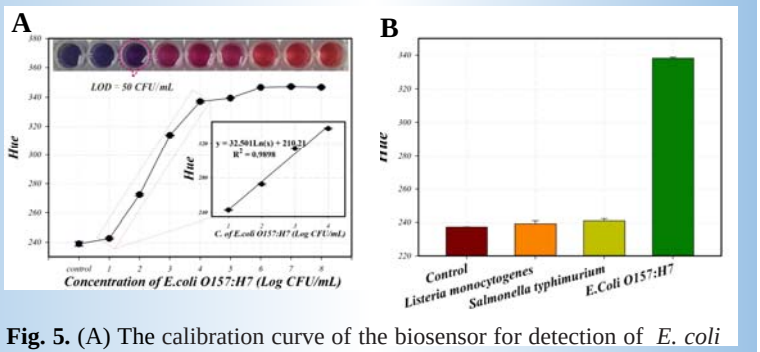

Fig. 5. (A) The calibration curve of the biosensor for detection of *E. coli* O157:H7 in chicken samples. (B) The specificity of the proposed biosensor

Conclusions

- This biosensor was able to detect *E. coli* O157:H7 as low as 50 CFU/mL within 30 min based on gold nanoparticle aggregation and smart phone for *E. coli* O157:H7 detection successfully.
- This biosensor showed its potential to provide a simple, low-cost and sensitive method for rapid screening of foodborne pathogens and could be easily extended for other biological or chemical targets.

Acknowledgment

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