

Nanoparticle Enhanced PCR Detection of Bacterial Aerosols

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Bioaerosol detection is of great importance in many fields, yet their low quantity in complex samples makes such an effort difficult. Here, we have investigated the use of nanoparticles (AgNPs, TiO₂NPs and their combination) assisted PCR (nanoPCR) in enhancing the efficiency. Pure bacterial species *E. coli* and *B. subtilis* with serial dilutions were tested for obtaining optimal parameters such as nanoparticle concentration and the volume of the nanoparticle mixture. These optimal parameters were then applied to detecting indoor and outdoor bacterial aerosols collected using a liquid impinger. The PCR products were subsequently subjected to agarose gel electrophoresis and DNA stain.

The results showed that the enhancements varied with nanoparticle type, concentration level, and DNA template concentration. Data with *E. coli* and *B. subtilis* revealed that the optimal parameters were: 0.6 nM for TiO₂NPs, 0.9 nM for AgNPs, 2 uL for the mixture, and diluted DNA templates. Our data also suggest that the mixture of AgNPs and TiO₂NPs performed better compared to their individual ones especially for lower DNA levels when coupled with qPCR. BacLight DNA stain results showed that use of nanoparticles could form nanoparticle-DNA clusters, which led to concentrating local DNA and thus

enhancing PCR detection. Our environmental bioaerosol monitoring data suggest that NanoPCR technique can be immediately applied to detecting low quantity of airborne biological materials with up to 500 times enhancement. The developments in this work can further broaden qPCR applications in bioaerosol research fields.

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