Immuno nanosensor for the ultrasensitive naked eye detection of tuberculosis

ABSTRACT

In the present study, a beneficial approach for the ultrasensitive and affordable naked eye detection and diagnosis of tuberculosis (TB) by utilizing plasmonic enzyme-linked immunosorbent assay (ELISA) via antibody-antigen interaction was studied.   Here,   the biocatalytic cycle of the intracellular enzymes links to the formation and successive growth of the gold nanoparticles(GNPs) for ultrasensitive detection. The formation of different colored solutions by the plasmonic nanoparticles in the presence of enzyme labels links directly to the existence or non-existence of theTB analytes in the sample solutions. For disease detection, the adapted protocol is based mainly on the conventional ELISA procedure that involves catalase-labeled antibodies, i.e., the enzymes consume hydrogen peroxide and further produce GNPs with the addition of gold (III) chloride. The amount of hydrogen peroxide remaining in the solution determines whether the GNPs solution is to be formed in the color blue or the color red, as it serves as a confirmation for the naked eye detection of TB analytes. However, the conventional ELISA method only shows tonal colors that need a high concentration of analyte to achieve high confidence levels for naked eye detection. Also,in this research, we proposed the incorporation of protein biomarker, Mycobacterium tuberculosisESAT-6-like protein esxB (CFP-10), as a means of TB detection using plasmonic ELISA. With the use of this technique, the CFP-10 detection limit can be lowered to $0.01\mu g/mL$ by the naked eye. Further,our developed technique was successfully tested and confirmed with sputum samples from patients diagnosed with positive TB, thereby providing enough evidence for the utilization of our technique in the early diagnosis of TB disease.

Keyword : Tuberculosis; Immune nanosensor; Plasmonic ELISA; Biosensors; Naked eye detection