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Smartphone-Based SARS-CoV-2 and Variants Detection System using Colorimetric DNAzyme Reaction Triggered by Loop-Mediated Isothermal Amplification (LAMP) with Clustered Regularly Interspaced Short Palindromic Repeats (CRISPR)

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Abstract

Coronavirus disease (COVID-19) has affected people for over two years. Moreover, the emergence of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) variants has raised concerns regarding its accurate diagnosis. Here, we report a colorimetric DNAzyme reaction triggered by loop-mediated isothermal amplification (LAMP) with clustered regularly interspaced short palindromic repeats (CRISPR), referred to as DAMPR assay for detecting SARS-CoV-2 and variants genes with attomolar sensitivity within an hour. The CRISPR-associated protein 9 (Cas9) system eliminated false-positive signals of LAMP products, improving the accuracy of DAMPR assay. Further, we fabricated a portable DAMPR assay system using a three-dimensional printing technique and developed a machine learning (ML)-based smartphone application to routinely check diagnostic results of SARS-CoV-2 and variants. Among blind tests of 136

clinical samples, the proposed system successfully diagnosed COVID-19 patients with a clinical sensitivity and specificity of 100% each. More importantly, the D614G (variant-common), T478K (delta-specific), and A67V (omicron-specific) mutations of the SARS-CoV-2 S gene were detected selectively, enabling the diagnosis of 70 SARS-CoV-2 delta or omicron variant patients. The DAMPR assay system is expected to be employed for on-site, rapid, accurate detection of SARS-CoV-2 and its variants gene and employed in the diagnosis of various infectious diseases.

논문정보

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