miRNAs and SNP Detection using Dynamic Chemistry Labelling

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Abstract:

MicroRNAs (miRNAs) and single nucleotide polymorphisms (SNPs) serve as valuable biomarkers for disease diagnosis due to their specificity and correlation with pathological conditions. This study presents a dual application of Dynamic Chemistry Labelling (DCL) for the detection of both miRNA isoforms and SNPs using nanoparticle-based strategies. We developed a dual nanosystem employing click chemistry to detect liver-specific miR-122 with single-base precision. This system enabled high-specificity detection via flow cytometry, showing strong correlation with TaqMan assays and successfully identifying single-base variants in serum and tumour cell lines. Concurrently, DCL was integrated into a Spin-Tube colorimetric assay for species-specific diagnosis of mucocutaneous leishmaniasis (MCL) and cutaneous leishmaniasis (CL) by targeting single nucleotide fingerprints in the hsp70 gene. This assay achieved single-copy sensitivity and visually interpretable results using standard PCR, enabling accurate Leishmania species differentiation in resource-limited settings. The technology was validated by identifying ten confirmed MCL patients. Together, these approaches demonstrate the versatility and robustness of DCL in addressing critical diagnostic challenges. Whether for miRNA isoform resolution in cancer or SNP-based pathogen identification in infectious diseases, DCL offers a powerful, accessible platform for precision diagnostics, with significant implications for early detection and personalized medicine.

Keywords:

Cancer diagnosis – nucleic acid detection – liquid biopsy.