Ultrasensitive fluorogenic detection of miR-144 with hybridization chain reaction and silver nanoclusters

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Abstract

Problem statement: MicroRNAs (miRs) are short single-stranded RNAs that regulate the pathophysiological processes in the body. On the onset of nasopharyngeal cancer, miR-144 is commonly dysregulated, which makes it a potential biomarker to improve current cancer diagnostics. This research proposes the development of a highly sensitive fluorescence biosensing system for the detection of miR-144 based on target-triggered isothermal hybridization chain reaction (HCR) and label-free fluorogenic silver nanoclusters (AgNCs).

Methodology: The DNA hairpins for HCR are designed to specifically recognise miR-144, and host the AgNCs forming site. miR-144 recognition opens these DNA hairpins at ambient conditions, to initiate a series of DNA hybridization events. This is followed by the preparation of AgNCs into the one-pot system to generate an amplified fluorescence signal.

Findings: Due to the design of the DNA hairpin monomers that promotes dual fluorescence signal output, the fluorescence biosensor exhibits ultrasensitive detection of miR-144, with a detection limit of 0.8 pM. Our proposed biosensor also displays selectivity towards the target miR-144, and is able to detect single base mismatch in the target sequence.

Conclusion: Our preliminary findings have shown promising progress in the development of a functional fluorescence nanobiosensor for miR-144. Overall, it has the potential to improve cancer diagnostics with comparable sensitivity, at a fraction of cost, time and effort required. Apart from that, this sensing platform can be developed as a universal approach for fast, sensitive and accurate detection of nucleic acid-based molecules.

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