Sensitive detection of triple-negative breast cancer-related microRNAs using pure DNA hydrogel

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Abstract

Triple-negative breast cancer is the most prevalent breast cancer in women with high invasiveness, recurrent risk, and mortality, as well as poor prognosis. MicroRNAs (miRNAs) play critical roles in cell proliferation, apoptosis, and gene expression regulation and their deregulation would be tumor-suppressive or oncogenic. Therefore, tremendous diagnostic, prognostic, and efficient therapeutic potential exists in understanding and targeting miRNAs in tumorigenesis. The combination of rolling circle amplification (RCA) and multi-primed chain amplification (MCA) was used to form DNA meta-hydrogel for the highly sensitive detection of three miRNAs in a one-pot reaction. miR-16p, a common miRNA expressed in healthy and cancer cells, was selected as a primer to initiate rolling circle amplification with a final concentration of 1.2 μM for 4 hours. Then, the mimics of miR-18a and miR-10a were added to the long single-stranded products for further amplification for 16 hours. These two miRNAs were added with different concentrations of 100 nM to 1 pM, and the intensity of the fluorescent signal was measured by adding the molecular beacon to the final products. Fluorescent miRNA biosensor offers a simple and highly sensitive method with a limit of detection (LOD) as low as 1 pM. The LOD of the present biosensor is comparable with the previous biosensors applied to detect only one miRNA. Therefore, the proposed biosensor offers a novel and effective strategy for the detection of multiple miRNAs using a combination of RCA and MCA. Execution of the parallel reactions in a microfluidic device would enable the detection of multiple miRNAs for highly sensitive, accurate, and early detection of TNBC for better therapeutic decision-making.

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