Electrochemical nanobiosensor for miRNA detection as early biomarkers of gastric cancer

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**Abstract**. Cancer remains a leading global health challenge, with gastric cancer posing a significant threat, particularly in South American regions like Chile, where it is the leading cause of tumour-related mortality1,2. Despite their utility, current tumour biomarker detection methods (i.e. RT-PCR, ELISA) suffer from limitations such as high cost, low throughput, and invasive sampling procedures3. Addressing these challenges, we developed an electrochemical biosensor leveraging hybrid dendritic nanomaterials coupled with peptide nucleic acids (PNA) for sensitively detecting of miR-21 and miR-150, both associated with gastric cancer. The nanocomposite was synthesized using a closed microwave reactor, and PNA probes were immobilized on PAMAM-modified working electrodes via biotin-avidin coupling. Electrochemical impedance spectroscopy (EIS) and cyclic voltammetry (CV) were employed throughout the sensor fabrication process. Sensitivity was optimized by evaluating probe concentration, incubation, blocking, and anchoring times. The sensor demonstrated high stability over a month at low temperatures and exhibited a linear response across a broad miRNA concentration range (1 aM to 1 μM). Notably, non-complementary miRNAs did not produce significant signal interference, ensuring high specificity. Preliminary tests using real plasma samples and cell cultures from healthy and cancer patients showed the sensor's capability to differentiate between miRNA expression levels in these groups, with results correlating with those obtained via square wave voltammetry (SWV) and EIS. Compared to similar studies, such as Zhuang et al.4, where a limit of detection (LOD) of 10 fM was reported for miR-21, our biosensor exhibited superior sensitivity with a LOD of 1 aM, surpassing previous designs like Pothipor et al.5, which reported a LOD of 1 fM for miR-21 using gold nanoparticle-enhanced electrochemical biosensors. In conclusion, this biosensor represents a promising tool for early gastric cancer detection, offering enhanced sensitivity, stability, and specificity, potentially facilitating point-of-care diagnostics.

**References:**

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