MOLECULAR IMPRINTED POLYDOPAMINE-BASED SENSOR FOR TETRACYCLINE DETECTION

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Tetracycline (TC) is a broad-spectrum antibiotic produced by Streptomyces and is widely used in livestock because of its effectiveness, low cost, and ease of administration [1]. However, residual TC in animal-derived foods can enter the human body through the food chain, posing significant health risks [2]. Accurate detection of TC and other antibiotic residues is therefore essential for pharmaceutical quality control, food safety, and environmental monitoring. Although conventional detection methods offer high sensitivity, they require costly instrumentation and complex procedures, highlighting the need for simple, cost-effective sensing platforms [1]. Molecularly imprinted polymer (MIP)-based sensors are synthetic recognition systems that mimic biological “lock-and-key” interactions, enabling selective detection of target molecules used as templates during imprinting [3].

In the present study, a MIP-based sensor was developed for the selective determination of tetracycline, using dopamine hydrochloride as the functional monomer and tetracycline as the template, thereby generating recognition sites complementary to the target’s molecular structure. MIP fabrication was performed via drop-casting of polydopamine nanoparticles synthesized via auto-oxidation of dopamine hydrochloride in Tris buffer (pH 8.5) and electrochemical polymerization via cyclic voltammetry in phosphate-buffered saline (PBS, pH 7.4), with TC. Non-imprinted polymers (NIPs) were prepared using the same procedure but without a template and served as controls. Template removal was performed by solvent washing with an ethanol-acetic acid mixture (9:1, v/v). Rebinding studies using electrochemical techniques, including cyclic voltammetry and electrochemical impedance spectroscopy, confirmed that MIPs exhibited enhanced sensitivity and selectivity for tetracycline compared with NIPs, demonstrating the system’s potential for tetracycline detection.

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Keywords: Molecular imprinted polymer, polydopamine, tetracycline, non-imprinted polymer

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