Electrochemical determination of enrofloxacin based on molecularly imprinted polymer via one-step electro-copolymerization of pyrrole and o-phenylenediamine

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PII: S1572-6657(17)30755-5
DOI: doi:10.1016/j.jelechem.2017.10.047
Reference: JEAC 3607

To appear in: *Journal of Electroanalytical Chemistry*

Received date: 19 April 2017
Revised date: 17 October 2017
Accepted date: 20 October 2017

Please cite this article as: Changling Yan, Ruixing Zhang, Yujuan Chen, Gongke Wang , Electrochemical determination of enrofloxacin based on molecularly imprinted polymer via one-step electro-copolymerization of pyrrole and o-phenylenediamine. The address for the corresponding author was captured as affiliation for all authors. Please check if appropriate. Jeac(2017), doi:10.1016/j.jelechem.2017.10.047

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Abstract:

A novel molecularly imprinted polymer (MIP), poly(pyrrole-co-o-phenylenediamine) (p(Py-co-OPD)), has been developed in order to construct a enrofloxacin(EF) sensor by using cyclic voltammetry (CV) technique. The preparation conditions including the pH level, EF concentration, the number of CV cycles, extraction solution of the template and the incubation time were optimized. The performance of the MIP sensor was evaluated by square wave voltammetry (SWV). Under the optimal experimental conditions, the MIP sensor exhibited long time stability, good selectivity and a wide linear range of 1.0×10^{-4}–1.0×10^{-10} mol/L with a low detection limit of 6.57×10^{-13} mol/L towards EF. Moreover, the sensor was successfully used to determine the EF amount in the pharmaceutical samples with satisfactory results.

1. Introduction

Enrofloxacin (EF) is a fluoroquinolone antibacterial with broad spectrum of activity and is used mainly in the treatment and prevention of animal diseases[1-3]. However, its abuse results into excessive residues in animal food products, leading to a harm to human's health[4-6]. Besides, EF also exist in soil. Some researchers detected surface soil samples and found that EF has produced toxic effects on organisms, including earthworms which are important to soil ecosystem. EF can accumulate in plants, and toxic effects exist in plants[7-10]. Thus, people pay more and more attention about the detection of excessive EF residues and make great progress in analytical technology, such as microbiological method[11], liquid chromatography-tandem mass spectrometry[12], high-performance capillary electrophoresis[13], high performance liquid chromatography[14,15]. But these methods are expensive, laborious, time-consuming, relatively poor sensitivity and are not environmentally friendly. Therefore, a sensitive, selective, economical and fast analytical method is urgently required for the quantitative detection of EF.

MIP is prepared through copolymerization of functional and cross-linking monomers in the presence of template molecules. After the removal of template, the imprinted cavities complemented in shape, size, and spatial distribution to the template are formed in the polymer matrix. These imprinted cavities selectively rebind the template molecule with a very high specificity[16-18]. Electrochemical molecular imprinting technique shows remarkable merits, such as the simple and tunable preparation procedure and provides fast mass-transfer and thickness controllable MIP thin films on electrodes[19-21]. This work reports the development of a novel sensor for EF based on electro-polymerized imprinted p(Py-co-OPD) on