Different Approaches for Antibiotic Quantification using Electrochemical Sensors and Nanomaterial's

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Abstract

Antibiotics are pharmaceutical substances that have saved many lives since they began to be used as medications for the treatment of infections. But over the years their use has multiplied, increasing the number of genes resistant to antibiotics. As a result, antibiotics now are included in the group of environmental pollutants and in the list of chemicals that must be monitored in food products. This fact has stimulated the interest of scientists and funding organizations to increase research in finding a fast, sensitive and accurate way to identify and monitor antibiotics.

Macrolides (Azithromycin and Erythromycin) and Glycopeptides (Vancomycin) are two of the antibiotic classes which have been used as a target for presented research work.

SPCIE (Screen Printed Carbon Ink Electrodes) modified with TiO_2 NPs are used as a working electrode in electrochemical analysis of Azithromycin (AZM). SEM analysis was performed to determine the physical and surface properties of the sensor. SPCIE/ TiO_2 NPs sensor using Cyclic Voltammetry performed well with a low limit detection (LOD) of 0.93 µM, limit of quantification (LOQ) 3.1 µM, sensitivity 7.36 $\mu A\ \mu M^{-1}\ cm^{-2}$ (S/N = 3) and linear range 0.05–50 µM towards determination of AZM. The sensor was applied successfully in urine and water samples. However, the sensor was not specific toward other Macrolide antibiotics such as Erythromycin, Clarithromycin etc.

To overcome the specificity issue of the sensor, electro-active molecularly imprinted polymers nanoparticles (e-MIP NPs) were developed for antibiotic quantification. Solid phase synthesis of e-MIP NPs was used to produce electro-active polymer. Together with other functional monomers, Ferrocene methyl methacrylate (FcMMA) was included as a redox-active monomer enabling the polymer to be a recognizer and reporter vs. specific targets in the same time (Fig. 1). Synthesized e- MIP NPs were applied on Screen Printed Electrodes (SPE) and showed an oxidation peak of FcMMA at about 0.3 V in Differential Pulse Voltammetry (DPV) using DropSens potentiostat. The further optimization of the method is developing in the lab.

Those new approaches for Antibiotic quantification may contribute in the attempts to find good alternatives for the determination and monitoring of antibiotics in environmental, food and human samples.

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Figures

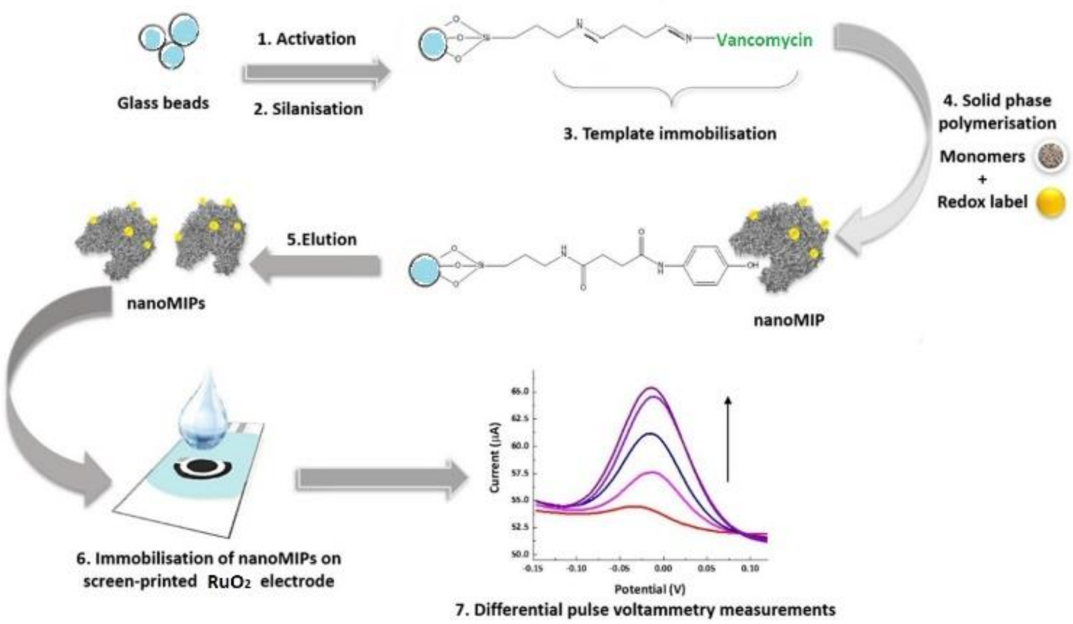

Figure 1: General principle for Electroactive Molecularly imprinted polymers Nanoparticles (e- MIP NPs) on SPE