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A novel printed 3-electrode system for the electrochemical detection of sulfadiazine

Ana P.M. Tavares[1,2*], M.G.F. Sales[1,2].

[1] *Biomark-CEB/ISEP, School of Engineering, Polytechnic Institute of Porto, Portugal;* [2]*CMEMS-UMinho, Universidade do Minho, DEI, Campus de Azurém, Guimarães, Portugal*

** ana.p.tavares90@gmail.com*

Electrochemical biosensors played an important role in advancing point-of-care (POC) detection systems, being well established for many years in analytical research. However, most of the devices consist on screen printed electrodes (SPEs) designed by printing suitable inks on different supports, mostly plastic, as PET or PVC, or ceramics. But an extended worldwide use of such SPE with synthetic and non-biodegradable support materials pose environmental concerns. A novel support is proposed herein to replace such non-eco-friendly materials, consisting on a natural compound that confers the required electrical and mechanical stability features to the final POC device.

As proof-of-concept, sulfadiazine (SDZ) was selected herein as target compound. SDZ is an antibiotic employed in fish health to improve production efficiency in aquaculture operations. The molecule recognition element used in this work is assembled by molecular imprinting technology by electropolymerizing Pyrrol in the presence of SDZ, on top a conductive layer of poly(3,4-ethylenedioxythiophene) (Figure 1). Electropolymerization was conducted by cyclic voltammetry and the template was removed by an alkaline solution.

The electrochemical performance of the resulting biomimetic sensor was evaluated by the direct detection of SDZ, in differential pulse voltammetry measurements. The results showed that the current signals increased for increasing concentrations of SDZ, revealing a good electroactive behaviour of this compound and the ability of the biomimetic film to recognize it. Moreover, the new devices displayed linear responses over from 8.0 to 152.0 µM, with good reproducibility and accurate readings. For comparison purposes, the same biomimetic element was assembled on commercial carbon SPEs of ceramic support prepared with the same PEDOT layer, and tested in parallel. In general, the sensitivity of biomimetic sensors prepared on the naturally-based substrates were better than commercial SPEs, yielding a higher sensitivity and a 10× lower limit of detection.

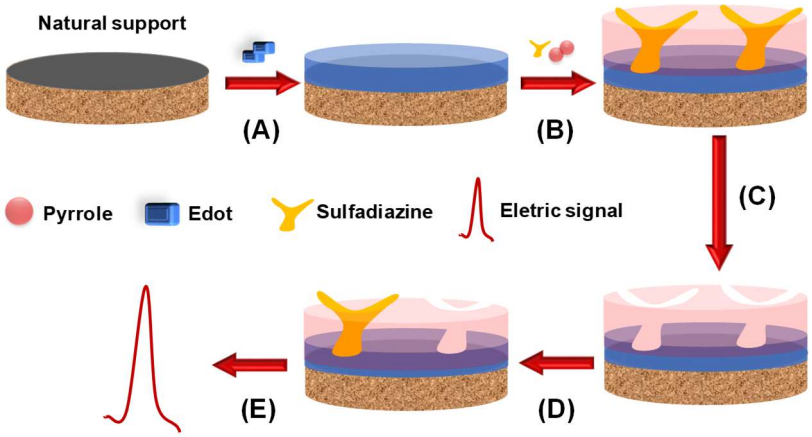

Figure 1: Synthesis of biomimetic sensor for detection Sulfadiazine. (A) Electropolymerizing EDOT; (B) Electropolymerizing Pyrrole in presence of template; (C) Template removal; (D) Rebinding the molecule to the biomimetic sensor; and (E) Electrical signal generated by the sensor in the molecule recognition process.

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