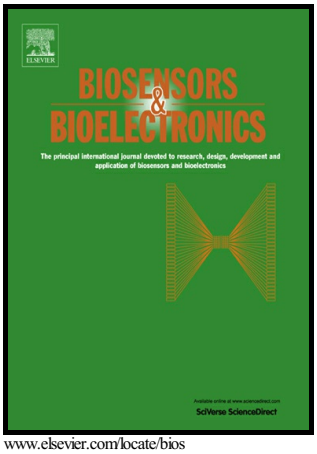

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Novel strategy for sulfapyridine detection using a fully integrated electrochemical Bio-MEMS: Application to honey analysis

Nadia El Alami El Hassani [a,b,c], Abdoullatif Baraket [c], Ernandes Taveira Tenório Neto [d], Michael Lee [c], Juan Pablo Salvador [e], Maria pilar Marco Colas [e], Joan Bausells [f], Nezha El Bari [a], Benachir Bouchikhi [b], Abdelhamid Elaissari [d], Abdelhamid Errachid [c], Nadia Zine [c]

[a] Biotechnology Agroalimentary and Biomedical Analysis Group , Department of Biology, Faculty of Sciences, Moulay Ismaïl University, BP 11201, Zitoune, Meknes, Morocco
[b] Sensor Electronic and Instrumentation Group, Department of Physics, Faculty of Sciences, Moulay Ismail University, BP 11201, Zitoune, Meknes, Morocco
[c] Université de Lyon, Institut des Sciences Analytiques, UMR 5280, CNRS, Université Lyon 1, ENS Lyon - 5, rue de la Doua, F-69100 Villeurbanne, France
[d] Université de Lyon, LAGEP, UMR-5007, CNRS, Université Lyon 1, 5007, 43 Bd 11 Novembre 1918, F-69622 Villeurbanne, France.
[e] Institute of Advanced Chemistry of Catalonia, Department of Chemical and Biomolecular Nanotechnology, C/ Jordi Girona 18-26 08034, Barcelona, Spain.
[f] Instituto de Microelectronica de Barcelona, IMB-CNM (CSIC) Campus UAB, 08193, Bellaterra, Barcelona, Spain.
Corresponding author: E-mail address: nadia.zine@univ-lyon1.fr

Abstract:

Sulfapyridine (SPy) is a sulfonamide antibiotic largely employed as veterinary drugs for prophylactic and therapeutic purposes. Therefore, its spread in the food products has to be restricted. Herein, we report the synthesis and characterization of a novel electrochemical biosensor based on gold microelectrodes modified with a new structure of magnetic nanoparticles (MNPs) coated with poly(pyrrole-*co*-pyrrole-2-carboxylic acid) (Py/Py-COOH) for high efficient detection of SPy. This analyte was quantified through a competitive detection procedure with 5-[4-(amino)phenylsulfonamide]-5-oxopentanoic acid-BSA (SA2-BSA) antigens toward polyclonal antibody (Ab-155). Initially, gold working electrodes (WEs) of integrated biomicro electro-mechanical system (BioMEMS) were functionalized by Ppy-COOH/MNPs, using a chronoamperometric (CA) electrodeposition. Afterward, SA2-BSA was covalently bonded to Py/Py-COOH/MNP modified gold WEs through amide bonding. The competitive detection of the analyte was made by a mixture of a fixed concentration of Ab-155 and decreasing concentrations of SPy from 50 µg L^{-1} to 2 ng L^{-1}. Atomic Force Microscopy characterization was performed in order to ensure Ppy-COOH/MNPs electrodeposition on the microelectrode surfaces. Electrochemical measurements of SPy detection were carried out using electrochemical impedance spectroscopy (EIS). This biosensor was found to be highly sensitive and specific for SPy, with a limit of detection of 0.4 ng L^{-1}. This technique was exploited to detect SPy in honey samples by using the standard addition method. The measurements were highly reproducible for detection and interferences namely, sulfadiazine (SDz), sulfathiazole (STz) and sulfamerazine (SMz). Taking these advantages of sensitivity, specificity, and low cost, our system provides a new horizon for development of advanced immunoassays in industrial food control.

Keywords:
BioMEMS, Magnetic nanoparticles (MNP), Biosensor, Sulfapyridine, Food control.

1. Introduction

Sulfonamides are amongst the most important drugs used to treat and in some cases prevent bacterial infection. Nevertheless, their effectiveness and easy access led to overuse, prompting bacteria to develop resistance phenomenon (Maddocks and Jenkins 2013) and