A Novel Electrochemical Sensor for Bisphenol A Detection Based on Molecularly Imprinted Polymer Coated Iron Oxide Nanoparticles

Rania Al Kaassamani[a], Simona Sawan[a], Nicole Jaffrezic-Renault[b], Rita Maalouf[a]

[a] Department of Sciences, Faculty of Natural and Applied Sciences, Notre Dame University - Louaize, Zouk Mosbeh, Lebanon.
[b] Institut des Sciences Analytiques, Université de Lyon, Claude Bernard Lyon 1, UMR 5280, CNRS - 5, rue de la Doua, 69100 Villeurbanne, France.

The European Food Safety Authority (EFSA) has recently updated the tolerable daily intake (TDI) of Bisphenol A (BPA), from 4 µg/kg bw per day to 0.2 ng/kg bw per day, reducing TDI by 20,000 times more than before. This change came as a result of the potent health effects of BPA as it can induce cancer and mutagenesis, and plays a vital role in hormonal disruption, immunosuppression, and infertility. Accordingly, the aim of this study is to prepare a novel sensor for the detection and possible removal of BPA from aqueous media. Molecularly Imprinted Polymers (MIP) was first prepared using iron oxide nanoparticles (Fe_3O_4 NPs) coated with (3-aminopropyl)triethyoxysilane (APTES) as the functional monomer, tetraethoxysilane (TEOS) as crosslinker and BPA as a template. The successful synthesis of the MIP was confirmed using Fourier transform infrared spectroscopy (FTIR). Boron-doped diamond electrodes were modified with the functionalized MIP/Fe_3O_4 NP_S and the template was removed by washing with a methanol/acetic acid solution. Electrochemical signal was recorded following the BPA response. The electrochemical performance of the proposed MIP based sensor was assessed by differential pulse voltammetry (DPV). Under optimum conditions, experimental results showed a linear response towards the BPA concentrations in the range from 1.5 to 120 µM, with a good sensitivity. The sensor also possesses a good stability, selectivity and high recovery range of more than 85% towards BPA in PBS buffer.

Keywords: Bisphenol A, BPA, molecularly imprinted polymer, Fe_3O_4 nanoparticles, differential pulse voltammetry