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Intellectual modifying a bare glassy carbon electrode to fabricate a novel and ultrasensitive electrochemical biosensor: Application to determination of acrylamide in food samples

Kambiz Varmira[a], Omid Abdi[a], Mohammad-Bagher Gholivand[b], Hector C. Goicoechea[c], Ali R. Jalalvand[a,*]

[a]*Research Center of Oils and Fats (RCOF), Kermanshah University of Medical Sciences, Kermanshah, Iran*

[b]*Department of Analytical Chemistry, Faculty of Chemistry, Razi University, Kermanshah, Iran*

[c]*Laboratorio de Desarrollo Analítico y Quimiometría (LADAQ), C_atedra de Química Analítica I, Universidad Nacional del Litoral, Ciudad Universitaria, CC ,242 (S3000ZAA), Santa Fe, Argentina*

**Corresponding Author: Tel.: +988334302345, Fax: +988334279745.* ali.jalalvand1984@gmail.com (A.R. Jalalvand)

ABSTRACT

Acrylamide (AA) is a neurotoxin and carcinogen which is mainly formed in foods containing large quantities of starch processed at high temperatures and its determination is very important to control the quality of foods. In this work, a novel electrochemical biosensor based on hemoglobin-dimethyldioctadecylammonium bromide (HG-DDAB)/platinum-gold-palladium three metallic alloy nanoparticles (PtAuPd NPs)/chitosan-1-ethyl-3-methylimidazolium bis(trifluoromethylsulfonyl)imide (Ch-IL)/multiwalled carbon nanotubes-IL (MWCNTs-IL)/glassy carbon electrode (GCE) is proposed for ultrasensitive determination of AA in food samples. Development of the biosensor is based on forming an adduct by the reaction of AA with α-NH_2 group of N-terminal valine of HG which decreases the peak current of HG-Fe^{+3} reduction. The modifications were characterized by electrochemical impedance spectroscopy (EIS), cyclic voltammetry (CV), energy dispersive X-ray spectroscopic (EDS) and scanning electron microscopy (SEM). Under optimized conditions, the biosensor detected AA by square wave voltammetry (SWV) in two linear concentration ranges of 0.03-39.0 nM and 39.0-150.0 nM with a limit of detection (LOD) of 0.01 nM. The biosensor was able to selective detection of AA even in the presence of high concentrations of common interferents which confirmed that the biosensor is highly selective. Also, the results obtained from further studies confirmed that the proposed biosensor has a short response time (less than 8 s), good sensitivity, long term stability, repeatability, and reproducibility. Finally, the proposed biosensor was successfully applied to determine AA in potato chips and its results were comparable to those obtained by gas chromatography-mass spectrometry (GC-MS) as reference method.