

Paper-Based Amperometric Sensor for Acetylcholinesterase Determination Using Screen-Printed Graphene Electrode

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Abstract:

Acetylcholinesterase (AChE) is an enzyme in cholinergic synapse which is an indicator of pesticides toxicity. Therefore, AChE activity determination is essential. In this work, a simple, rapid, sensitive, and selective paper-based electrochemical sensor for determination of AChE was firstly developed. A screen-printed graphene electrode (SPGE) was used as a working electrode due to its excellent electrical conductivity, electron mobility, high sensitivity, and cost effectiveness. The amperometric determination of AChE is based on the electrochemical signal of thiocholine (TCh) which is generated from the hydrolysis of acetylthiocholine (ATCh) by AChE. For AChE detection, ATCh immobilized sheet was stacked onto the detection sheet using double adhesive tape. After that, AChE samples were dropped onto the back side of an ATCh immobilized sheet and incubate for only 60 s. Then the oxidation current was generated from TCh which can be measured by amperometric method. The interferences of AChE determination, which is glutathione (GSH), can be avoided by applying the potential of 0.5 V vs. Ag/AgCl onto the SPGE and the oxidation current which related to AChE concentration was measured. Under optimal conditions, a linear range of the developed sensor in the range of 0.1 to 15 U/mL and the limit of detection (LOD) of 0.1 U/mL were obtained. Additionally, the proposed sensor was successfully applied for the AChE determination in blood samples and the results were in good agreement with a spectrophotometric method which is conventional method.

Key words: paper-based sensor, screen-printed graphene electrode, acetylcholinesterase, glutathione, amperometric method