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Acetylcholinesterase/gold nanoparticle/mesocellular foam silica biosensor for pesticide detection in real samples

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Determination of pesticide residues in food, water, and the environment is crucial for the well-being of human and animals. This is because organophosphates and carbamates, two groups of widely applied pesticides in the agriculture, could inhibit cholinesterase enzyme which then may cause pyrolysis and finally death (Perry et al., 1998) to the livings. The main aim of this work is, therefore, to develop acetylcholinesterase (AChE)-based sensor for detection of pesticides in vegetables, fruits, and waters. Disposable screen-printed carbon and gold electrodes were both investigated as underlying substrates of modified electrodes. The electrodes were modified by immobilization of AChE in gold nanoparticle (AuNP)-decorated mesocellular foam silica (MCF), and the chitosan film was then cast over to cover the said nanoparticles. MCF is a type of mesoporous silica with remarkable specific surface area (can be up to 1,500 m2g-1;Ispas et al., 2008), appropriate pore sizes for enzyme immobilization and enhancing enzyme stability (Chouyyok et al., 2009). Moreover, incorporation of AuNPs helps enhancing electrical conductivity of the enzyme carrier. Interestingly, synergic effects between MCF and AuNPs tremendously enhanced current responses. The biosensors were tested for their performances with 4 types of pesticides, namely; chlorpyrifos, methyl parathion, carbaryl and methomyl. Primary tests with samples extracted from pesticide laden cabbage demonstrated that the biosensor could detect 500 ng/mL of methyl parathion.

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