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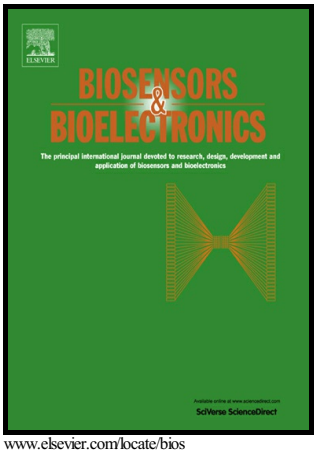

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Label-free immunosensor based on one-step electrodeposition of chitosan-gold nanoparticles biocompatible film on Au microelectrode for determination of aflatoxin B_1 in maize

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ABSTRACT

Gold nanoparticles (AuNPs) embedded in chitosan (CHI) film, well-dispersed and smaller in size (about 10 nm), were fabricated by one-step electrodeposion on Au microelectrode in solution containing chitosan and chloride trihydrate. The nano-structure CHI-AuNPs composite film offers abundant amine groups, good conductivity, excellent biocompatibility and stability for antibody immobilization. The combination of aflatoxin B_1 (AFB_1) with immobilized antibody introduces a barrier to electron transfer, resulting in current decreasement. The morphologies and characterizations of modified microelectrodes were investigated by scanning electron microscope (SEM), cyclic voltammetry (CV), electrochemical impedance spectroscopy (EIS) and Fourier transform infrared spectroscopy (FT-IR). The proposed non-enzyme and label-free immunosensor exhibited high sensitive amperometric response to AFB_1 concentration in two linear ranges of 0.1 to 1 ng mL^{-1} and 1 to 30 ng mL^{-1}, with the detection limit of 0.06 ng mL^{-1} (S/N=3). The immunoassay was also applied for analysis of maize samples spiked with AFB_1. Considering the sample extraction procedure, the linear range and limit of detection were assessed to be 1.6-16 ng mL^{-1} and 0.19 ng mL^{-1} respectively. The simple method showed good fabrication controllability and reproducibility for immunosensor design.

Keywords:
Aflatoxin B_1; Microelectrode; Immunosensor; Chitosan; Gold nanoparticle; Electrodeposition

1. Introduction

Aflatoxins were first identified in 1961 in contaminated animal feed responsible for the deaths of 100 000 turkeys in the United Kingdom (Blount, 1961). Aflatoxins, produced as secondary metabolites mainly by fungi Aspergillus flavus and Aspergillus parasiticus, are known to be potent toxic, carcinogenic, teratogenic and mutagenic (IARC, 2002). Especially, naturally occurring aflatoxin B_1 (AFB_1) is considered to be the most dangerous mycotoxins for human health and is evaluated as category Group 1 by IARC (International Agency for Research on Cancer), which indicates there is sufficient evidence of carcinogenicity in exposed humans (IARC, 2002). Being common and widespread in nature, aflatoxins have been found in a variety of agriculture commodities, but the most pronounced contamination has been encountered in maize, peanuts, cottonseed and tree nuts (IARC, 2002). The intake of agriculture commodities and food contaminated by aflatoxins may significantly threaten to the health of human beings.

Climate in the production area is the most important factor influencing the preharvest

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