Ultrasensitive Immunosensor for Aflatoxin B₁ Detection Based on Screen-Printed Carbon Electrode Modified by Ferrocene @Multi-Walled Carbon Nanotubes

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An electrochemical immunosensor for the ultrasensitive detection of aflatoxin B₁ (AFB₁) in agricultural products was developed. Ferrocene (Fc), with favourable oxidation-reduction properties, is widely used in chemically modified electrodes. Multi-walled carbon nanotubes (MWNTs) have good catalytic activity, chemical stability and electronic transport properties. Chitosan (CS) can promote membrane formation and improve adhesion. Fc was fixed on the surface of a screen-printed carbon electrode (SPCE) via MWNTs and CS, and then the Fc@MWNT nanostructure was formed. The increased specific surface area of SPCE modified by Fc/MWNT/CS facilitated the binding of AFB₁-BSA, while the excellent electrical conductivity of Fc/MWNT/CS promoted electron transfer. These advantages not only amplified the immunosensor signal but also made the prepared immunosensor have high sensitivity, selectivity and stability. Under optimal conditions, the proposed immunosensor obtained a wide linear range from 10^{-3} ~ 2×10^4 ng/mL and a low AFB₁ detection limit of 0.159 pg/mL via cyclic voltammetry (CV) and differential pulse voltammetry (DPV). Its stability and effect on actual sample detection were also proven in this paper. This new immunosensor achieved favourable stability, reproducibility and selectivity and had potential application in real sample analysis.

Keywords: ferrocene, multi-walled carbon nanotubes, immunosensor, AFB₁

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