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A portable paper-based electrochemical device for determination of the total inorganic arsenic using a gold nanoparticle modified boron-doped diamond electrode

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In this work, an electrochemical Paper-Based Analytical Device (ePAD) was fabricated and applied to detect the total inorganic arsenic in rice samples using Gold Nanoparticles modified Boron-Doped Diamond Electrode (AuNP/BDDE). This sensor can perform electrode modification step with gold nanoparticles using electro-deposition method and As(III) detection step using Square-Wave Anodic Stripping Voltammetry (SWASV) within the same device. In order to determine the total Arsenic Concentration, As(V) was firstly reduced to As(III) using sodium thiosulfate as a reducing agent at room temperature because only As(III) can be detected with the modified electrode. Under optimal condition, the surface morphology of AuNPs/BDD electrode investigating by Scanning Electron Microscopy (SEM) presented that the diameter size of spherical gold nanoparticles was approximately 70-90 nm. Moreover, a Limit of Detection (LOD) was found to be 20 ng mL^{-1} for As(III) (The maximum arsenic concentration limit in rice at 1.0 mg/kg has been established by the Food and Agriculture Organization/World Health Organization (FAO/WHO)). The obtained results show good precision and reproducibility. Moreover, the developed sensor was successfully applied for a sensitive determination of the total inorganic arsenic in rice samples. Therefore, this sensor held a great promising as an alternative tool for a simple device, small sample volume (μL scale), low-cost, short response time and high accuracy.

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