Fabrication of an Effective Gold Nanoparticle/Graphene/Nafion® Modified Glassy Carbon Electrode for High Sensitive Detection of Trace Cd²⁺, Pb²⁺ and Cu²⁺ in Tobacco and Tobacco Products

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The heavy metal contamination in tobacco (*nicotiana tabacum*) and tobacco products was investigated in this study. Samples of commercially available cigarettes and traditional Philippine cigars, dried tobacco leaves, tobacco stalk, and soil were tested to confirm their heavy metal content. The World Health Organization (WHO) limits for Cd²⁺, Pb²⁺, and Cu²⁺ are 3 ppb, 10 ppb and 2 ppm, respectively. All the cigarette brands and variants in this study are all way above the WHO's toxicity limits for the aforementioned heavy metals. Henceforth, all the cigarette variants in this study can be inferred to be dangerously toxic. The heavy metal detection was done with a glassy carbon electrode modified with gold nanoparticles (AuNP), graphene and Nafion® using the drop coating method. The modified electrodes were optimized by varying the concentration of graphene and AuNP and their effects were subsequently determined by the measurement of their analytical sensitivity, limits of detection, and limits of quantitation. Atomic absorption spectroscopy was performed to validate the concentrations of the heavy metals detected via anodic stripping voltammetry. The statistically insignificant difference between the concentrations detected through anodic stripping voltammetry and atomic absorption spectroscopy shows that the modified electrodes exhibited optimum detection properties. In addition, the transfer factors from soil to tobacco stalk, as well as, soil to tobacco leaf were also computed.

Keywords: Anodic stripping voltammetry, gold nanoparticles, graphene, Nafion®, heavy metals, glassy carbon electrode, tobacco, cigarettes

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