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Analytical applications of the GPU electrode for determination of daidzein

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Abstract – The performance of the GPU composite electrode over the daidzein determination was evaluated by differential pulse voltammetry (DPV). Parameters such as pulse amplitude, sweep rate were optimized. A calibration curve was obtained with linear region between 9,92x10^{-7} and 8.50x10^{-6} mol L^{-1} and detection limit of 1.31x10^{-7}.

Since the earlier 1960s many different procedures to prepare solid carbon-based electrodes for electroanalytical use have been proposed. Among these solid electrode materials one can highlight the composites in which the carbon is dispersed in polymeric matrices. Mendes et al. [1] first described the preparation and use of the graphite–polyurethane composite electrode (GPU). The advantages of GPU electrode, such as their properties and potential applications, especially in the determination of organic compounds attracted very recently considerable attention for the electroanalytical applications.

Daidzein is a flavonoid widely found in fruits and vegetables such as soybeans. This flavonoid, along with others numerous secondary metabolites, is involved in direct and indirect plant defense against insect herbivores and pathogens [2]. For these reasons, the rapid determination and reliable quantification of daidzein are important for genetic manipulation of plants and the search for alternative pest management tools. Since most flavonoids are electrochemically active at moderate oxidation potentials, electrochemical methods are preferable with the advantages of higher sensitivity and less interference from non-electroactive substances. Thus, the present work describes the performance of GPU for the determination of daidzein in a differential pulse voltammetric procedure.

Differential pulse voltammetric measurement was performed at GPU electrode in 5.0x10^{-5} mol L^{-1} daidzein solution in BR buffer pH 2. The voltammogram obtained for the electrode is presented in Fig. 1, from which it is possible to observe one anodic peak at 730 mV which is a characteristic of daidzein oxidation. The peak current is associated with the oxidation of the 4'-hydroxyl electron-donating group at ring B. The influence of the parameters pulse amplitude and scan rate on the anodic peak was studied with the purpose of increasing the signal obtained for daidzein. Thus, the effect of the pulse amplitude on the GPU electrode response was investigated between 10 and 100 mV in 5.0x10^{-5} mol L^{-1} daidzein solution in BR buffer pH 2. The highest analytical signal was obtained at 100 mV. After that, the scan rate was studied ranging from 5 to 50 mV. The best scan rate for DPV was 10 mV s^{-1}. Thus, these experimental conditions were selected for further experiments. Under the optimized conditions, a linear response of anodic peak current as a function of the daidzein concentration was obtained (Fig.2) in the investigated range 9.92 x10^{-7}- 8.40x10^{-6} mol L^{-1} (n=10). In this range, a limit of detection of 1.31x10^{-7} mol L^{-1} can be found. Thus, these results suggest that the GPU electrode is suitable for the determination of daidzein in soybeans, represent good sensitivity, rapid responses and fast response.

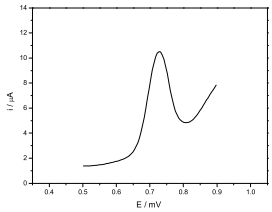

Figure 1: Differential pulse voltammogram obtained at GPU electrode using 5.0x10^{-5} mol L^{-1} daidzein solution in BR buffer. Scan rate 10 mV s^{-1} and pulse amplitude 100 mV.

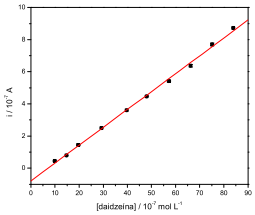

Figure 2: Analytical curve obtained for daidzein at the GPU electrode.

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