The Ex-situ Electrochemical Determination of Bioactive Compounds: The Influence of Surface and Nano-modifiers

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Abstract

The hormone Estradiol has significant study interest as a bioactive compound responsible for the reproduction [1-3]. This study focuses on the *ex-situ* electrochemical determination of estradiol and investigates the influence of surface and nano-modifiers on the analytical performance. Bare carbon paste electrodes, including expanded carbon, CR-2, and CR-5, were used for comparison. Silicon oil served as the pasting liquid. The response of CR-2 and CR-5 electrodes was superior to expanded carbon for the same estradiol concentration of 1 µM, indicating the importance of the conductive carbon type. A consistent optimal adsorption time of 5 minutes was observed for all electrodes.

The introduction of surface modifiers yielded notable changes in the electrode response. Substituting 5% of CR-5 weight with amorphous carbon and cyclodextrin led to decreased responses and performance, respectively. In contrast, the inclusion of 5% and 10% Halloysite nano-clays resulted in slightly improved responses, associated with a prolonged extraction time of 10 minutes. Moreover, increasing the nano-clay content in the paste further enhanced the response. Incorporating 5% carbon multiwall nanotubes in the paste displayed a lower response and longer adsorption time (10 minutes) compared to bare CR-2 and CR-5 carbon paste electrodes. The highest response among the considered surface modifiers was observed when functionalized carbon multiwall nanotubes were used, with an optimal adsorption time of 15 minutes.

Furthermore, changing the pasting liquid from silicon oil to ionic liquids yielded significantly improved responses compared to most of the modifiers used, with an optimal adsorption time of 10 minutes. These results demonstrate the impact of surface and nano-modifiers on the electrochemical determination of bioactive compounds, highlighting the importance of careful selection and optimization of these modifiers for enhanced analytical performance.

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