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Electrooxidation of Quercetin in aqueous medium under preconcentration conditions

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This study aimed to investigate the oxidation mechanism of the antioxidant quercetin (QCT) using electroanalytical techniques. A glassy carbon electrode (GCE) or carbon paste electrode (CPE) was employed as the working electrode, with Ag/AgCl (KCl saturated) and platinum serving as the reference and auxiliary electrodes, respectively. Cyclic voltammetry (CV) was performed in phosphate buffer (pH 7.4) until the baseline stabilized. Subsequently, voltammograms were recorded in a 10 μM QCT solution after a preconcentration step at 0 V for 4 minutes. All measurements were carried out in the potential range of 0.0 V to +1.0 V, with a scan rate (ν) of 0.1 Vs^{-1}. To analyze the oxidative process in different stages, the potential windows selected were: 0.0 to +0.24 V, 0.0 to +0.35 V, 0.0 to +0.50 V, and 0.0 to +0.65 V. The anodic-to-cathodic peak current ratio (I_p,a/I_p,c) increased with the scan rate, suggesting an ECE (Electrochemical–Chemical–Electrochemical) mechanism. The charge transfer coefficient (β) was determined using Tafel analysis. At scan rates up to 0.1 $V{\cdot}s^{-1}$, $\beta < 1$, indicating that the first electron transfer is the rate-determining step. At higher scan rates, $\beta > 1$, suggesting that the second electron transfer becomes rate-determining. After modifying the CPE by chronoamperometry in a 10 μM QCT solution, the resulting electrode (CPE/QCT) was rinsed and reintroduced into the QCT solution. A new anodic peak at +0.11 V was observed, indicative of a two-electron transfer process. The significative adsorption of QCT onto the electrode surface highlights the need for working in mixed or apolar solvents to minimize surface fouling and improve reproducibility.

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References:

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