Electrochemical determination of capsaicin using a reduced graphene oxide paste electrode

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Capsaicin, the main pungent compound in chili peppers, is widely used in food, pharmaceutical, and forensic fields. Conventional quantification methods, such as high-performance liquid chromatography (HPLC) and gas chromatography-mass spectrometry (GC-MS), are accurate but expensive and time-consuming. Electrochemical techniques, particularly voltammetry, offer a rapid and cost-effective alternative. This study reports the development and application of a reduced graphene oxide paste electrode (rGOPE) for the determination of capsaicin in acidic medium [1].

The rGOPE was fabricated by homogenizing reduced graphene oxide with paraffin and heating the mixture at 60 °C to ensure uniformity. Electrochemical characterization was performed using cyclic voltammetry (CV) and square wave voltammetry (SWV) in 50 mM Britton-Robinson buffer (pH 1.7). Capsaicin oxidation presented an irreversible peak at +0.67 V (vs. Ag/AgCl), corresponding to its conversion into o-benzoquinone, followed by a reversible redox pair related to catechol formation.

SWV analysis showed a linear response from 1.43 to 11.35 µM with R^2 = 0.993 (n = 3). The method displayed a sensitivity of 0.4971 µA L µmol^{-1}, a detection limit (LD) of 0.70 µM, and a quantification limit (LQ) of 2.32 µM. Despite a gradual decrease in current due to o-benzoquinone accumulation, the sensor maintained acceptable repeatability (RSD = 13.31%) and reproducibility (RSD = 19.24%). Interference studies indicated that ascorbic acid did not significantly affect capsaicin detection after ethanol extraction. The applicability of rGOPE was validated with real pepper samples, showing excellent agreement with HPLC data.

These findings demonstrate the potential of rGOPE as a promising tool for routine capsaicin analysis, offering a simpler and more economical approach for food safety, quality control, and pharmaceutical applications.

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References:

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