ABSTRACT - TECHNOLOGICAL INNOVATION;

ELECTROCHEMICAL ASSESSMENT OF THIOL ANTIOXIDANT CAPACITY USING ABTS AS A REDOX MEDIATOR

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Background. ABTS•+ is widely used in spectrophotometric assays of antioxidant capacity. Here we explore a rapid electrochemical alternative to quantify the reactivity of biologically relevant thiols toward ABTS at neutral pH.

Methods. Cyclic voltammetry (phosphate buffer, pH 7.0) was performed with ABTS fixed at 0.20 mM and each thiol—N-acetylcysteine (NAC), cysteine, homocysteine, and glutathione (GSH)—varied from 0.05 to 0.20 mM. Scan rates were 10–100 mV s^{-1}. From the voltammograms we obtained: (i) the cathodic peak current (I_{pc1}) versus $\sqrt{v}$, and (ii) the ratio I_{pa}/v versus v.

Results. In the presence of all thiols, I_{pc1} increased linearly with $\sqrt{v}$, indicating diffusion-controlled catalysis. The linear fits (I_{pc1} vs $\sqrt{v}$) showed strong correlation for NAC (R^2 = 0.990), cysteine (R^2 = 0.998), and GSH (R^2 = 0.998); homocysteine also followed the trend with a single deviating point (R^2 = 0.847). Sensitivities (slopes of I_{pc1} vs $\sqrt{v}$, in $\mu A \cdot V^{-1/2} \cdot s^{1/2}$) ranked GSH (18.3) > homocysteine (16.7) > cysteine (14.6) ≈ NAC (14.1), suggesting higher catalytic efficiency for GSH and homocysteine under our conditions. Complementarily,

I_pa/v decreased consistently as v increased from 0.01 to 0.10 V s^{-1}—by ~78% (NAC), 70% (GSH), 67% (homocysteine), and 64% (cysteine)—a behavior characteristic of EC′-type mediation where chemical regeneration of the mediator limits current at lower scan rates. Together, these two diagnostics ($I_{pc1} \propto \sqrt{v}$ and declining I_pa/v with v) support an ABTS-mediated catalytic mechanism for all tested thiols at pH 7.0.

Conclusions. The data demonstrate the feasibility of a simple ABTS-mediated voltammetric protocol to rank thiol antioxidants and lay the groundwork for an electrochemical antioxidant capacity metric based on the slope of I_{pc1} vs $\sqrt{v}$ and/or catalytic current gains. Ongoing work extends the approach to phenolic antioxidants.

Palavras-chave: abts; cyclic voltammetry; thiols; antioxidant capacity; electrochemical catalysis.