

# Maximizing the adsorption efficiency in electrochemical determinations: Insights into electrode surface modifications

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## Abstract

The precise assessment of antioxidants in wine is crucial for evaluating its quality and health benefits. Catechins, prominent antioxidants found in wine, significantly contribute to its overall antioxidant capacity. These polyphenolic antioxidants also play a vital role in maintaining the color stability of wine during aging. Electrochemical measurements provide a reliable method of quantifying catechins in wine due to their sensitivity and specificity. However, it is essential to optimize the efficiency of catechin adsorption onto electrode surfaces to enhance the accuracy and precision of these measurements.

This study aims to explore strategies for improving the adsorption efficiency in electrochemical determinations of catechins in wine. Various approaches are investigated to maximize the adsorption of catechins onto the electrode surface. These include evaluating the impact of different types and sizes of graphite, assessing the influence of binding oil and its concentration, investigating the optimal adsorption time, and optimizing other experimental conditions such as electrode material, pH, temperature, and scan rate. A comparison is also drawn between the in-situ method, which entails the direct measurement of a solute within a solution, and the ex-situ method, wherein the electrode is immersed in the analyte solution, subsequently withdrawn, and transferred into the measuring solution. Once the method optimizations are completed, real wine samples sourced from different regions of Albania are tested. The quantification of catechins in these wine samples is performed using the differential pulse voltammetry (DPV) technique, which offers high sensitivity and selectivity in detecting and measuring these antioxidant compounds. The successful implementation of the investigated adsorption enhancement strategies demonstrates a significant improvement in the accuracy and precision of catechin determination in wine samples.