

A Gold Leaf Electrochemical Sensor for Formaldehyde Adulteration Analysis in Foods

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Abstract

Illegal addition of formaldehyde to fresh foods remains a food safety concern in many countries despite strict regulatory control. Rapid and reliable analytical methods are therefore essential for routine food inspection and on-site screening. This presentation describes the development of a low-cost electrochemical sensor based on a gold leaf three-electrode platform for the quantitative determination of formaldehyde in foods. The disposable sensor integrates a gold leaf working electrode with printed carbon counter and Ag/AgCl reference electrodes on a flexible plastic substrate, providing a simple and inexpensive sensing platform with a fabrication cost of approximately US\$0.20 per device.

Formaldehyde was determined by square-wave voltammetry in alkaline medium, requiring less than 2 min per analysis. The sensor exhibited a linear response over the concentration range of 0.2–2.0 mM with excellent linearity ($R^2 = 0.996$) and a limit of detection of 0.093 mM. Its electrochemical performance was comparable to that of a commercial gold screen-printed electrode while offering substantially lower fabrication cost. In addition to direct immersion (batch-mode) measurements, the same sensor can also be integrated into a continuous-flow system, demonstrating its versatility for different analytical applications. The method was successfully applied to representative food samples, providing satisfactory recoveries between 96% and 112%. The combination of low cost, rapid analysis, analytical reliability, and versatile operation demonstrates the potential of gold leaf electrochemical sensors as practical tools for routine food adulteration monitoring and food safety control.

Keywords: Formaldehyde; Food adulteration; Gold leaf sensor; Electrochemical sensing; Food safety