An Electrochemical Approach for the Determination of the Fruit Juice Freshness Using Carbon Paste Electrode Modified with ZnO Nanorods

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The presence of citric acid in food products is directly related to their color and taste, leading to the freshness of the products. Here, detection of citric acid in fruit juice were investigated using ZnO nanorods based carbon paste electrode (Z-CPE) through the electrochemical methods. A facile aqueous solution technique was used to synthesize ZnO nanorods and Z-CPE was prepared by dropping the dispersed ZnO nanorods in methanol on the surface of CPE. X-ray diffraction, transmission electron microscopy and field emission scanning electron microscopy analyses of prepared ZnO nanorods showed the ZnO nanorods were synthesized in high density of hexagonal phase. Cyclic voltammetry, differential pulse voltammetry, and electrochemical impedance spectroscopy techniques were conducted for electrochemical study of Z-CPE. Electrochemical analyses showed charge transfer behavior was facilitated due to the presence of high aspect ratio and high effective surface area of ZnO nanorods in the electrode surface. Study on the concentration effect of citric acid on Z-CPE indicated a linear relationship between peak current and citric acid concentration (0.5 mM to 6 mM as calibration range). The detection limit and sensitivity of citric acid sensor were estimated 0.998 $\mu\text{A}/\mu\text{M}$ and 3 nM, respectively. The results show that ZnO nanostructures can be of great help to enhance electrochemical sensors for detection of citric acid as an important element in juices, especially citrus fruits.

Keywords: ZnO nanorods; Carbon paste electrode; Citric acid; Electrochemical technique; Cyclic voltammetry; Electrochemical impedance spectroscopy

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