Advancing Antibiotic Detection: Engineering a Novel Chitosan-Zinc Oxide-Modified Graphite Electrochemical Sensor for Ciprofloxacin Detection

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The contemporary bioaccumulation of Antibiotics in our environment due to various factors has resulted in significant pollution, predisposition of organisms to adverse health effects, and the exacerbation of the antibiotic resistance crisis. In the pursuit of addressing their ever-pervasive impact and gaining a precise, quantitative understanding of their presence in various substances, sensors remain indispensable. Many detection methods for antibiotics attribute high detection limits and are fraught with lack of sensitivity and economic feasibility. However, electrochemical sensing has emerged advantageous due to its accuracy, low-cost, scalable, and rapid nature. This study investigated electrochemical detection of Ciprofloxacin, a synthetic fluoroquinolone, which is one of the most abundant antibiotics in usage/circulation, through fabrication of a novel graphite Chitosan-Zinc Oxide (CH-ZnO) modified electrochemical sensor. Using a low-cost arduino-based potentiostat and three-electrode system to conduct Cyclic Voltammetry, I was able to evaluate and optimize both the ratio of the sensor modification and its composition of the electrode sensor (determined to be 20% of 3:2 ratio of Chitosan to Zinc-Oxide), test interference of heavy metals and other antibiotics on the sensor (Amoxicillin and Penicillin), and analytically determine the precise concentrations of Ciprofloxacin. The sensor showed a detection limit of 0.097 μM, one of the lowest reported in literature, high accuracy of 98.9%, and a low standard deviation of 3%. Furthermore, it maintained high accuracies of detection >97% in interference tests, showing great potential for Ciprofloxacin detection for several applications including medical and environmental screening due to its unique chemical framework.

Awards Won:

Third Award of $1,000