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Towards Sustainable Monitoring: Innovating Electrochemical Biosensors for Pesticide Detection in Seawater

The widespread presence of pesticides in food, water, and soil poses significant environmental and health concerns, particularly organophosphorus and carbamate insecticides known for their toxicity. These pesticides inhibit acetylcholinesterase (AChE) activity, crucial for nervous system function. Traditional methods like colorimetry, capillary electrophoresis, and high-performance liquid chromatography are effective but complex and costly. Biosensing offers a simpler, faster, and more cost-effective approach.

This study focuses on developing an electrochemical biosensor to indirectly monitor AChE activity targeting pollutants like carbendazim and malathion in seawater. AChE's catalytic activity is studied using cyclic voltammetry with p-acetoxyphenol as a substrate, producing an electroactive product (hydroquinone) detectable via electrochemistry.

Key to the biosensor's development is immobilizing the enzyme by encapsulating it in a sol-gel silica matrix. Kinetic and inhibition studies confirm the relationship between added pollutant concentration and enzyme activity inhibition.

This biosensor offers promise for early detection of marine contaminants, contributing to sustainable environmental monitoring efforts.

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