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Bienzymatic Biosensors Based on Acetylcholinesterase and Butyrylcholinesterase for the Screening of Insecticides from Waters

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Abstract: Neurotoxins of natural (cyanotoxins) or anthropogenic (insecticides) origins have a dramatic impact on human and environmental health. Fast environmental screening with cholinesterase-based biosensors is a useful approach to monitor and prevent potential harmful effects on resident fauna and/or humans. The biosensors based on enzymatic inhibition are able to simultaneously detect a relatively large spectrum of analytes with significant variations in sensitivity depending on the organism source and eventual genetic modifications. Monoenzymatic biosensors, usually based on acetylcholinesterase (AChE; EC 3.1.1.7) or, to a lesser extent on butyrylcholinesterase (BChE; EC 3.1.1.8), fail to provide information over the entire spectrum of the inhibitors since there are compounds that specifically inhibit one of the two enzymes, e.g. methomyl inhibits only acetylcholinesterase while pirimicarb inhibits the butyrylcholinesterase at much lower concentrations than the acetylcholinesterase. A bienzymatic biosensor with both acetylcholinesterase and butyrylcholinesterase co-immobilized on a single electrode has the advantage that each neurotoxic compound is detected by the enzyme with the highest affinity in just one measurement.
Conclusions and perspectives

- development of an improved bi-enzymatic biosensor based on co-immobilized AChE and BChE
- extension of the insecticides spectrum detected by a single measurement
- detection of all the neurotoxic insecticides regardless of the enzyme that is primarily inhibited operational conditions for the bienzymatic biosensor were optimized for both enzymes
- AChE is more sensitive to methomyl than BChE, and BChE is more sensitive to pirimicarb than AChE
- one cyanobacteria strain induces dose-dependent inhibition of both AChE and BChE
- BChE is more sensitive to the guanitoxin-like compound.

Keywords: Neurotoxic Screening; Cholinesterase Biosensors; AChE–BChE Co-immobilization; Insecticide Detection; Cyanotoxin Sensitivity.

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References

1. Radulescu, M.C.; Bucur, M.P.; Bucur, B.; Radu, G.L. Acetylcholinesterase and Butyrylcholinesterase Co-Immobilized on a Copper-Containing Prussian Blue Modified Electrode for the Broad Screening of Insecticides. *Anal. Bioanal. Chem*. **2024**, *416*, 5059–5070. https://doi.org/10.1007/s00216-024-05443-1.

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