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Cholinesterase-based biosensor using Lates calcarifer (Asian Seabass) brain for detection of heavy metals

Abstract

Heavy metals are sometimes needed for nutrient uptake but only in low concentrations and the nervous system is the most susceptible to be affected. Cholinesterase (ChE) inhibition has been used extensively as a biomarker for heavy metals detection. In this study, the potential of ChE from Lates calcarifer brain as an alternative biosensor for heavy metals is evaluated. There are many Malaysian rivers such as Sungai Juru and Sungai Merbok that are greatly polluted by industrial effluents. Chronic exposure to heavy metals may cause nervous system disorders. Thus, a fast and simple biomonitoring technique will help in alerting government agencies and the public to such a threat. In this study, ChE from the brain of L. calcarifer (Asian seabass) was purified through ammonium sulphate precipitation and ion exchange chromatography. Enzyme recovery was 5.31% with a specific activity of 5.472 U mg^{-1}. The Michaelis-Menten constant (Km) value was 0.3075 mM and a Vmax of 0.0304 µmol min^{-1} mg^{-1}. ChE from L. calcarifer brain showed higher affinity to acetylthiocholine iodide (ATC) compared to butyrylcholinesterase (BTC) and propionylcholinesterase iodide (PTC). Maximum activity of ChE was detected when the enzyme was assayed at the temperature of 20-30°C and incubated in Tris-HCl buffer pH 8.0. Silver (Ag), arsenic (As), cadmium (Cd), chromium (Cr) and mercury (Hg) showed more than 50% inhibition amongst the 10 types of heavy metals that have been tested for inhibition study. These results can be used to further develop an alternative way to detect heavy metals that are low cost and give faster results compared to existing biosensor kits.

Keywords

Biomarker; Biomonitoring; Cholinesterase; Heavy metals