A new biosensing material based on sol-gel encapsulated housefly acetylcholinesterase: characterisation and application

ABSTRACT

A new biosensing material based on sol-gel encapsulation with enzyme wasdeveloped for the rapid screening of organophosphate residues. The newly developed biosensor prototype can utilise this biosensing material as abioreceptor. The encapsulation was carried out at room temperature and phosphate buffer was used to minimise the denaturation of enzymes. Three typesof organophosphate pesticides with different toxicity i.e. dichlorvos (category I ï highly toxic and hazardous compound), chlorpyrifos and fenitrothion (category IIï slightly toxic compounds) were used in this study. The calibration plots for dichlorvos, chlorpyrifos and fenitrothion with dynamic range between 0.2ï 1.0ppm, 20ï 100 ppm and 125 ï 725 ppm respectively were obtained. Competitive inhibition was observed when halves of maximum inhibition (I50) of these organophosphate pesticides (OP) were reacted with variousconcentrations of substrate, acetylthiocholine iodide (ATCI). Enzymatic inhibition showed that the response of the biosensing material to these OP was highly reproducible. The lower percentage of enzyme leaching (20%) shows that the microencapsulation process is able to entrap enzyme in the sol-gel matrix. The enzyme-doped sol-gel monolith was found to be stable at least for 3 months under storage at 4 °C. In addition, the gel can be mass-produced thus making it disposable after a single use. Recovery data were collected for dichlorvos on two varieties of vegetables, amaranth or chinese spinach (Amaranthus viridis) and convolvulus (Ipomoea aquatica). The percentage recovery of approximately 80% for spiked samples with average RSD of 2.44% shows that this newly developed biosensing material can be used as a bioreceptor for the biosensor device.

Keyword: Biosensing material; Sol-gel; Acetylcholinesterase; Organophosphate pesticides; Encapsulation