

Article
Reagentless Bidirectional Lateral Flow Bioactive Paper Sensors for Detection of Pesticides in Beverage and Food Samples

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Abstract


A reagentless bioactive paper-based solid-phase biosensor was developed for detection of acetylcholinesterase (AChE) inhibitors, including organophosphate pesticides. The assay strip is composed of a paper support (1 × 10 cm), onto which AChE and a chromogenic substrate, indophenyl acetate (IPA), were entrapped using biocompatible sol-gel derived silica inks in two different zones (e.g., sensing and substrate zones). The assay protocol involves first introducing the sample to the sensing zone via lateral flow of a pesticide-containing solution. Following an incubation period, the opposite end of the paper support is placed into distilled deionized water (ddH₂O) to allow lateral flow in the opposite direction to move paper-bound IPA to the sensing area to initiate enzyme catalyzed hydrolysis of the substrate, causing a yellow-to-blue color change. The modified sensor is able to detect pesticides without the use of any external reagents with excellent detection limits (bendiocarb ~1 nM; carbaryl ~10 nM; paraoxon ~1 nM; malathion ~10 nM) and rapid response times (~5 min). The sensor strip showed negligible matrix effects in detection of pesticides in spiked milk and apple juice samples. Bioactive paper-based assays on pesticide residues collected from food samples showed good agreement with a conventional mass spectrometric assay method. The bioactive paper assay should, therefore, be suitable for rapid screening of trace levels of organophosphate and carbamate pesticides in environmental and food samples.

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