Development of films based on tapioca starch/gold nanoparticles for the detection of organophosphorus pesticides

ABSTRACT

Organophosphorus pesticides (OPs) are used in crops to eradicate pests, but are of concern to the public, attributable to their potential toxicity to human health. In the present study, a biodegradable composite film containing citrate-stabilized gold nanoparticles (AuNPs) was developed to detect pesticides. The proposed composite film has distinctive structural and functional characteristics as a colorimetric recognition indicator for detecting OPs (malathion, fenthion, dimethoate, and chlorpyrifos). The developed film was morphologically and spectroscopically characterized through electron microscopy and UV–Vis spectrometry, respectively. The spherical-shaped and monodispersed AuNPs were obtained with an average particle size of 20 nm. The aggregation of the AuNPs composite film in the presence of pesticides led to a change in color from red to blueish purple, which could be visually observed on the surface of the vegetables. Under optimum conditions, the detection limit was 2.02 μM, 1.33 μM, 2.27 μM, and 11.77 μM for malathion, fenthion, dimethoate, and chlorpyrifos, respectively. The developed films demonstrated good biodegradability, and excellent storage stability, sensitivity and selectivity, with recovery values ranging from 99.60 to 103.68%, and relative standard deviation (RSD) values from 0.56 to 5.76%. The findings indicate a sensitive and selective sensing biodegradable colorimetric film, which is eco-friendly, biodegradable, considered to have promising low-costs, and a renewable source material for detecting pesticide residues.