

Detection of Chlorpyrifos Residues in Spinach Using GC-MS: Evaluation of Cleaning Agents for Residue Reduction

Hilmy Hakim, Siti Raihan Zakaria*

Structured Abstract

Background: The presence of pesticide residues in vegetables poses a significant concern for food safety and environmental health. Chlorpyrifos (CPF), a widely used organophosphate pesticide in agriculture, often persists on the surfaces of edible plants such as spinach. Given rising health concerns related to dietary pesticide exposure, this study aimed to evaluate the effectiveness of various household washing agents in removing CPF residues from spinach leaves. Additionally, the study assessed the linearity and reliability of a Gas Chromatography–Mass Spectrometry (GC-MS) method for pesticide detection and quantification.

Methods: Standard chlorpyrifos solutions at concentrations of 200, 300, 400, and 500 ppm were analysed to construct a calibration curve, which was subsequently used to evaluate GC-MS method linearity and quantify CPF in treated spinach samples. Fresh spinach was procured from a local market and artificially spiked with 200 ppm CPF solution to simulate contamination. The samples were then subjected to four washing treatments: tap water, 10% sodium bicarbonate, 10% acetic acid, and 5% sodium chloride. Following washing, chlorpyrifos residues were extracted using Solid Phase Extraction (SPE) with C18 cartridges and analysed via GC-MS

Results: The GC-MS calibration curve exhibited excellent linearity with the regression equation $Y = 0.0538x - 2.676$ and a correlation coefficient (R^2) of 0.9852, indicating high method reliability. Among the washing agents, 10% sodium bicarbonate was the most effective in reducing CPF residues, followed by 10% acetic acid and 5% sodium chloride. Tap water demonstrated the lowest removal efficiency, likely due to the hydrophobic nature of chlorpyrifos.

Conclusion: The GC-MS method demonstrated robust linearity and reliability for CPF detection in vegetables. Household washing with 10% sodium bicarbonate proved to be the most effective in minimizing pesticide residues, highlighting its potential for safer vegetable consumption and enhanced food safety practices.

Keywords: Chlorpyrifos, green spinach, pesticide residues, GC-MS, household washing

*Correspondence: sitiraihan@uitm.edu.my

School of Chemistry & Environment, Faculty of Applied Sciences, Universiti Teknologi MARA, Shah Alam, Malaysia