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Method development for the determination of MCPA (4-Chloro-2-methylphenoxy acetic acid) residues in black tea

A M T Amarakoon^{1*}, K N S Herath¹, P A N Punyasiri² and K R W Abewickrama^{3,1}

¹*Department of Chemistry, University of Kelaniya, Kelaniya*

²*Tea Research Institute, Thalawakale*

³*Analytical Laboratory, Sri Lanka Tea Board, 574, Galle Road, Colombo 03*

Food safety regulations in many countries necessitate the routine analysis of pesticide residues in agricultural products where pesticides have been used in crop production. At present 27 pesticides are recommended for use in tea plantations in Sri Lanka, and residues of these are analyzed employing multi residue methods (MRMs) using GC-MS. However, these MRMs cannot be employed for the analysis of MCPA as derivatization is required for the detection of MCPA. When adapting established methods for the pesticide residue analysis in black tea, complications arise due to the presence of high amounts of complex polyphenolic compounds, and often modifications are required when adapting the method. Therefore, the aim of this study was to develop a simple method, using commonly available chemicals, for the routine analysis of MCPA residues in the complex matrix tea.

Pre-extraction with aqueous methanol, liquid-liquid partitioning with dichloromethane and derivatization with acidic methanol, were optimized for the matrix of black tea. The conditions for the GC-MS analysis were also optimized. The limit of detection (LOD) and the limit of quantification (LOQ) of the method were 1.3×10^{-3} mg kg⁻¹ and 2.7×10^{-3} mg kg⁻¹, respectively. Therefore, the method could be used for the detection and quantification of MCPA residues in black tea, as the maximum residue level (MRL) for tea is 0.1 mg kg⁻¹. The average mean recovery for the three spiked levels (0.05, 0.10, 0.20 mg kg⁻¹) was 97.64%. Precision expressed as Relative Standard Deviation (RSD) was 4.58%. The method developed was successfully applied for the analysis of MCPA residues in selected commercial black tea samples produced in Sri Lanka. The results indicated that the MCPA residue level in these samples were well below the MRL for MCPA. Thus, derivatization into methyl ester followed by GC-MS could be used for routine monitoring of black tea for MCPA residues.

Keywords: Black tea, 4-chloro-2-methylphenoxy acetic acid (MCPA), gas chromatography-mass spectrometry (GC-MS), maximum residue level (MRL), pesticide residue analysis