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ULTRA-LOW DETECTION OF METANIL YELLOW IN AQUEOUS MEDIUM BY SURFACE ENHANCED RAMAN SPECTROSCOPY

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Abstract

Surface-Enhanced Raman Spectroscopy (SERS) is a sensitive technique to detect chemical compounds with a distinct structural fingerprint. Recently, the potential of SERS has been recognized to detect food colourants. This study was conducted with the objective of ultra-low detection of metanil yellow (MY), in an aqueous medium by SERS. MY is a non-permitted, synthetic food colourant used in Sri Lanka. Most of the synthetic food colourants show adverse effects on human health. Hence, the detection of colour components in food is essential. Although there are some existing methods, SERS can be used as an alternative ultra-sensitive method to detect food colourants. Molecular sensitivity of SERS can be enhanced by amplifying Raman intensity through electromagnetic enhancement due to localized surface plasmon resonance and chemical enhancement caused by charge transfer from Raman active molecules to affinity level of adsorbed molecules. Metallic nanoparticles, prominently Au and Ag have been used as Raman active molecules. In this study, a concentration series of MY as 125 ppm, 25 ppm, 2.5 ppm, and 0.25 ppm were analysed using a Thermo Scientific DXR2 SmartRaman spectrometer in a range of 400 cm^{-1} to 1800 cm^{-1} at an excitation wavelength of 785 nm and laser power of 50 mW. Raman spectra were obtained for aqueous solutions of pure MY, MY+Ag nanocolloids mixture, and MY+Ag nanocolloids+$MgSO_4$ mixture, in triplicates. $MgSO_4$ was used to boost the Raman intensity further in order to sense ultra-low concentrations. Raman peaks were observed at 1616 cm^{-1}, 1589 cm^{-1}, 1454 cm^{-1}, 1392 cm^{-1}, 1325 cm^{-1}, 1155 cm^{-1} and 998 cm^{-1} for MY molecule. In conclusion, Ultra-low concentration of 0.25 ppm (250 ppb) of MY was sensed by SERS with this developed technique. However, with further optimizations, SERS could be used as a potential method in detection and quantification of various colour constituents in different matrices.

Keywords: Metanil yellow, AgNPs, ultra-low detection, SERS, Food safety.