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OPTIMIZATION OF Ag NANOPARTICLES TOWARDS THE DETECTION OF MICROCYSTIN-LR IN AQUEOUS MEDIUM BY SURFACE ENHANCED RAMAN SPECTROSCOPY

Silva E.L.C.[1*], Bandara B.R.M.V.[1], Dheerasinghe M.J.[1,5], Rajapaksha G.K.M.[1,3,5], Aponso G.Y.G.[2], Nisansala H.M.D.[3,5], Pamunuwa K.M.P.P.K.[1], Fernando P.E.J.[4,5], Abeysiri H.A.S.N.[2,5,6], Patabendige C.N.K.[3], Pathmalal M.M.[2,5,6]
and Sirimuthu N.M.S.[1]

[1]Department of Chemistry, Faculty of Applied Sciences,
University of Sri Jayewardenepura, Sri Lanka
[2]Department of Zoology, Faculty of Applied Sciences,
University of Sri Jayewardenepura, Sri Lanka
[3]Department of Science for Technology, Faculty of Technology,
University of Sri Jayewardenepura, Sri Lanka
[4]Department of Polymer Science, Faculty of Applied Sciences,
University of Sri Jayewardenepura, Sri Lanka
[5]Faculty of Graduate studies, University of Sri Jayewardenepura, Sri Lanka
[6]Centre for Water Quality and Algae Research,
Department of Zoology, University of Sri Jayewardenepura, Sri Lanka
lakshansilva277@gmail.com

Abstract

Cyanobacterial blooms pose a major threat to the drinking water treatment industry due to their ability to produce different congeners of Microcystins (MCs). Microcystin-LR (MC-LR) has recorded as the most potent microcystin which is fatal to humans, livestock, pets, and aquatic life even at very low concentrations. Current cyanotoxin detection methods base on ELISA, HPLC and LC-MS analysis that require expertise. Molecular detection techniques are conventionally based on optical, electrochemical, electronic or gravimetric methodologies. Among these methodologies, Surface Enhanced Raman Spectroscopy (SERS) is considered as one of the most reliable, ultra-sensitive and cost-effective method. It has become a selective and label free technique for non-destructive molecular analysis through the amplification of electromagnetic fields and/or creation of charge transfer states between the chemisorbed species and SERS active platform. Metal nanoparticles (eg: Au, Ag and Cu) have been commonly exploited as SERS active platforms. The present study reports the use of SERS to detect MC-LR as a novel method. In this study the obtained Raman peaks for MC-LR along with silver nanoparticles were boosted using $MgSO_4$ as an enhancement reagent. According to results of UV analysis, observed λ_{max} for synthesized Ag nanocolloid was at 408 nm. Qualitative and semi-quantitate determination of ubiquitous MC-LR was carried out under various conditions and the method was optimized by changing the matrix parameters to develop a better calibration plot by changing the nanoparticles to MC-LR ratio for different aggregation agents. 1:4 nanocolloide to MC-LR ratio gave the best enhancement along with the $MgSO_4$. Currently, concentrations of 1 ppb level were sensed with this optimized technique. But, with further optimizations, this method could be served as a cost-effective novel technique in ultra-low detection and quantification of MC-LR in various environmental samples.

Keywords: Silver nanoparticles, Microsystin-LR, SERS, Ultra-low concentrations