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Morphological and Molecular Characterization of Microcystin-Lr Producing Cyanobacteria in Beira and Boralesgamuwa Lakes, Sri Lanka

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Abstract

The proliferation of toxic and non-toxic cyanobacteria in freshwater ecosystems has emerged as a critical ecological and public health concern, particularly in urban environments where eutrophication and anthropogenic runoff accelerate bloom formation. Among cyanobacterial toxins, microcystin-LR (MC-LR) is one of the most potent hepatotoxins, frequently implicated in deteriorating water quality and health risks. This study aimed to investigate the occurrence of MC-LR-producing cyanobacteria in two major urban recreational lakes in Sri Lanka, Beira Lake and Boralesgamuwa Lake, by integrating morphological and molecular approaches. Triplicate surface water samples were collected from each lake to enhance statistical reliability, reduce random variability, and ensure MC-LR-producing cyanobacteria reflected true lake conditions. The samples were subsequently concentrated through sequential centrifugation. Cyanobacterial morphotypes were initially identified microscopically, with species such as *Microcystis aeruginosa*, *Microcystis incerta, Oscillatoria gardhii*, and *Spirulina* sp. Genomic DNA was subsequently extracted from concentrated samples using thermal lysis, followed by centrifugation to obtain DNA-rich supernatants. Polymerase Chain Reaction (PCR) amplification was performed using gene-specific primers targeting the *mcy*A and *mcy*B gene clusters, which are critical for MC-LR biosynthesis. Amplification products were analyzed by agarose gel electrophoresis alongside a 100 bp DNA ladder for size confirmation. Microscopic examination revealed variations in species dominance between the two lakes, *Spirulina* sp. was dominant in Beira Lake, while *Oscillatoria gardhii* and *Lyngbya limnetica* were more abundant in Boralesgamuwa Lake. Nevertheless, toxin-producing *Microcystis* species were consistently observed in both sites. Molecular analysis confirmed the presence of the *mcy*A gene in all six samples. In contrast, the *mcy*B gene was absent in two samples, Beira 1 and Boralesgamuwa 3, suggesting potential strain-level variation, partial gene loss, or genetic degradation within these populations. The presence of both toxin-producing and non-toxin-producing cyanobacteria in recreational lakes, along with the detection of toxin genes, indicates serious potential for MC-LR contamination that poses health risk to local communities engaged in recreational and occupational activities.

Keywords: *Cyanobacteria, Microcystin-LR, Polymerase chain reaction, Toxic blooms, Water quality monitoring*