The First Report on Microcystin-LR Occurrence in Eastern Cuban Water Reservoirs and Environmental Trigger Factors

Hazel Scarlett*

Editorial office, International Journal of Innovative Research in Science, Engineering and Technology, Brussels, Belgium

Corresponding Author*

Hazel Scarlett

Editorial office

International Journal of Innovative Research in

Science, Engineering and Technology, Brussels

Belgium

E-mail: innovativeresearch@scienceresearchpub.org

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Abstract

In the Cuban context, the elements connected to cyanotoxin incidence and societal effect, with understanding and risk perception being the most critical difficulties, are not fully known. The goals of this study were to estimate the risk extension and microcystin-LR levels in 24 water reservoirs in eastern Cuba, as well as to investigate the environmental conditions that promote toxic cyanobacteria growth and microcystin-LR occurrence. Sampling was done in the early morning hours, within situ determination, and physicochemical analysis was done in the lab. Microcystin-LR levels in water and within cells (intracellular toxins) were evaluated by UPLC–MS analysis following solid-phase extraction. Eutrophication was discovered in the reservoirs tested, with high levels of TN: TP ratio and phytoplankton cell densities, high water temperatures, and low transparency, resulting in collateral effects such as cyanobacterial bloom and microcystin-LR occurrence. Concentrations of MC-LR more than the WHO limit for drinking water (1 gL1) were identified in the reservoirs of Hatillo, Chalons, Parada, Mcara, Baragua, Cautillo, La Yaya, Guisa, and Jaibo.

Keywords: Cyanobacteria • TN: TP • Microcystin-LR • UPLC–MS • Water reservoir

Introduction

The increasing eutrophication of aquatic environments caused by industrial development promotes the massive growth of microorganisms such as cyanobacteria; these species are capable of producing potent toxins (i.e., microcystins and cylindrospermopsins), which affect drinking water and aquatic organisms throughout the food chain. The repercussions of cyanotoxin poisoning or injury are often addressed in the medical profession, resulting in enormous economic expenses. Some environmental parameters, such as pH, spectral irradiance, and temperature, can impact the growth of hazardous phytoplankton species in bodies of water. Furthermore, eutrophication happens as a result of agriculture and urbanization, allowing some cyanobacteria species to grow quickly and generate blooms.

Furthermore, the current climate change may boost the growth of hazardous cyanobacteria. The presence of cyanotoxin, as well as the absence of techniques to avoid and/or mitigate cyanotoxin, has resulted in serious consequences for animal and human health, which are a global issue. Microcystin is the most researched cyanotoxin, with over 90 variations, the most dangerous and extensively spread being microcystin-LR (MC-LR). It is critical to remember that one of the most significant measures of human progress is water coverage. Water reservoirs are a crucial problem in terms of cyanotoxin risk management owing to their societal effect; a systematic monitoring strategy is required, as well as legislative steps to prevent harm to human and/or animal health.

Even though agriculture is designated as the primary use for water reservoirs in Cuba, drinking water supply is the most significant and difficult usage since it requires water treatment availability and management to meet acceptable water quality requirements. Water concerns are critical at the national level because of the likelihood of droughts shortly and the trophic state of water supplies.

There are loopholes in Cuban legislation regarding the existence of cyanobacteria and cyanotoxin and their possible consequences. Although cyanotoxin levels in water reservoirs must be determined, there is some indication of potentially hazardous cyanobacteria presence. As a result, there is no mention of this problem in the established national guidelines for examining water quality in connection to water reservoir usage, and there is a low sense of this risk. Similarly, research on poisonous cyanobacteria is sparse in Cuba, however, there are some highlights from studies conducted in the country's east.

Globally, the occurrence of harmful Microcystis, Oscillatoria, and Anabaena species in water reservoirs has been often observed, with Microcystis dominating. The presence of certain potentially harmful species was later recorded in additional reservoirs, with the Microcystis genus having the most species, with six: M. aeruginosa, M. comperei, M. flos-aquae, M. panniformis, M. viridis, and M. wesenbergii. Other reservoirs needed to be researched to understand the extent of the risk, and the key suggestion of this earlier research was to assess the number of main toxins linked with the previously found hazardous cyanobacteria.

Because significant information gaps exist in the Cuban context, the elements connected to cyanotoxin occurrence and its societal impact are not yet totally known; some of the most essential are those previously indicated (the grasp of the risk extension and key cyanotoxin levels). The goal of this article is to investigate the risk extension as well as the primary environmental variables that cause hazardous cyanobacteria growth and microcystin-LR levels in selected water reservoirs in eastern Cuba.

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