



Abstract

# Cyanotoxins (Microcystins) in Water Irrigation: Evaluation of Contamination, Detoxification Process in Plant-Animal Food Chain Model and Human Health Risk <sup>†</sup>

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**Abstract:** Under the effect of climate change and eutrophication, cyanobacterial blooms occur in surface waters; these cyanobacteria are capable of producing secondary metabolites called cyanotoxins. Among these cyanotoxins, microcystins (MCs) are the most common and most harmful to human and animal health. Agricultural plants come into direct contact with microcystins (MCs) during irrigation with waters containing cyanotoxins (MCs), whereas animals and humans may come across MCs following the consumption of initially contaminated agricultural products. The objective of this work was to evaluate the bioaccumulation, transfer and detoxification of MCs in plants (*Fragaria vulgaris* L.) and a nuisance animal (*Meriones shawii*). *F. vulgaris* culture was conducted under hydroponic conditions. All plants were irrigated using 0, 1, 5, 10 and 20 µg/L of MCs for 60 days. Besides, aliquots (10 g) of fruit from the treated plants were prepared to feed *M. shawii* previously divided into five groups with six animals each for 4 consecutive weeks. All experimental procedures were performed in accordance with Cadi Ayyad University's animal care guidelines and European Decree 1, February 2013, for the ethical use of animals for experimental purposes (NOR: AGRG1238767). We made efforts to reduce pain and the number of *Meriones* used in this study. The results reported a decreasing accumulation of toxins in different organs of the plant (perlite > roots > leaves > stems > fruits). With the obtained results, the bioconcentration factor (BCF) and the acceptable daily intake (ADI) were determined in order to gauge the health risk. Furthermore, the glutathione S-transferase (GST) and glutathione reductase (GR) activities were also evaluated. The highest activities were recorded in *F. vulgaris* roots and *M. shawii* liver. The results of this study indicated the possible bioaccumulation and transfer of MCs throughout the food chain, in addition to the involvement of enzymes such as GSH and GR in the detoxification process of MCs.

**Keywords:** microcystins; *Fragaria vulgaris*; *Meriones shawii*; bioconcentration; irrigation; hydroponic culture; bioconcentration factor; acceptable daily intake

**Author Contributions:** Conceptualization, M.H., F.E.K., A.C., L.T. and B.O.; methodology and experiments, M.H., R.M., E.M.R., J.A., M.J.A., M.L.S. and Y.E.; data acquisition and formal analysis, M.H.; writing—preparation of original draft, M.H.; writing—review and editing, M.H., E.M.R., R.M., F.E.K., V.V. and B.O.; supervision, B.O. and F.E.K.; project administration, A.C.; acquisition of funding, A.C., V.V. and B.O. All authors have read and agreed to the published version of the manuscript.

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