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# Toxic effects of zinc on anaerobic microbiota from Zimapán Reservoir (Mexico)

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**Abstract**

The toxic effects of heavy metals have been extensively documented in different organisms. Nevertheless, a lack of information exists with regard to this topic in the case of autochthonous microorganism communities. The aim of this study was to evaluate the toxic effects of zinc on the anaerobic microorganisms present in the sediment and anoxic water of Zimapán Reservoir (Mexico), with particular focus on dissimilatory sulphate reducing bacteria. In the laboratory, a system of enrichment microcosms was set up with sediment and water from the reservoir. ATP, protein, carbohydrates and lactate and alcohol dehydrogenase activity were determined. The physicochemical parameters of the reservoir were evaluated over the course of one year. Sulphate reduction occurred in the reservoir throughout the year, but was most pronounced at the end of the wet season and during winter. In the field, increases in the rate of sulphate reduction coincided with the lowest levels of total phosphorus and hydrosoluble organic carbon. Zinc enrichment was observed to modify protein and carbohydrate content as well as to affect lactate and alcohol dehydrogenase activity. All responses followed a zinc concentration–response relationship and were dependent on reservoir physicochemical parameters. ATP content was used as a biomarker to evaluate the sublethal toxic effects of zinc. The acceptable threshold concentration of zinc in the aquatic and sediment enrichment microcosms was determined to be 0.06 mg Zn/L and 711.1 mg Zn/kg, respectively.



*Keywords:* Dissimilatory sulphate reducing bacteria; ATP; Alcohol dehydrogenase; Lactate dehydrogenase; Zinc

## 1. Introduction

Zimapán Reservoir, located in the Río Moctezuma-Pánuco basin, is the second deepest inland water body in Mexico (maximum depth 203 m). The reservoir lake has two branches stretching along the course of the Río Tula and Río Moctezuma, at the confluence of which is the water gate. Through these two major tributaries the reservoir receives wastewater discharges from Mexico City and the states of Mexico, Querétaro and Hidalgo. These wastewaters are purified in wetlands as well as by the similative capacity of the watercourses. Located in an arid region, the reservoir has a total storage capacity of $1460 \times 10^6 m^3$ [1] and its water is used for restricted irrigation. Because of its depth and water characteristics, prevalence of extensive anoxic zones as well as heavy metal deposition in its sediment are to be expected. Anaerobic

*Abbreviations:* ADH, alcohol dehydrogenase; DSRB, dissimilatory sulphate reducing bacteria; Eh, Redox potential; HOC, hydrosoluble organic carbon; LDH, lactate dehydrogenase; POC, particulate organic carbon

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