Séminaire International sur
l'Hydrogéologie et l'Environnement
12 – 14 Mars 2019, Ouargla (Algérie)

ENZYMATIC EFFECTS OF ZnO ON AQUATIC PLANT USED IN WASTEWATER TREATMENT

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Abstract: The research aimed to understand the behavior of aquatic plants subjected to xenobiotics, a macrophyte plant *Phragmites australis* from the region of Souk-Ahras, is treated with three concentrations based on zinc oxide (ZnO) (3, 6 and 12 nmol· mL^{-1}): for 7, 14 and 21 days. A measurement of no enzymatic parameters characteristic of oxidative stress allowed us to evaluate not only the effect of zinc oxide but also the behavior of *Phragmites australis* subjected to this nanometric molecule. The statistical analysis of the results obtained showed no significant differences in all the parameters measured, between leaves and roots. The results of the analysis of heavy metals in wastewater, revealed values lower than the Algerian norm with the exception of Zn. On the other hand, we noticed a high concentration of Zn and a low concentration of Fe and Pb. This result makes it possible to conclude that the wastewater is characterized by a pollution of the metallic type loaded with partially degradable effluents.

Keywords: *enzymatic activity, heavy metals, oxidative stress, Phragmites australis, phytoremediation, wastewater, ZnO*

INTRODUCTION

The Oued Medjerda is one of the most important wet area characterized by a permanent flow over all of its course, located in the north-east of Algeria and various contaminants are detected. *Phragmites australis* is the most abundant species and the most used as a biological indicator of pollution because of its ability to accumulate various pollutants.
The study aims to evaluate the effect of ZnO nanoparticles on a macrophyte plant (*Phragmites australis*) in both compartments (roots and leaves). Our macrophyte is taken from Oued Medjerda site.

MATERIALS AND METHODS

The experimental pilot consists of nine aquariums (41.5 cm long, 20.5 cm wide and 27.5 cm high), filled by a succession

of three layers: two composed of gravel of decreasing diameter and the third which is the thickest, consists of sand. These aquariums with 8 liters of wastewater are planted with reeds (*Phragmites australis*) - 3 plants/aquarium, under the conditions of the laboratory with 3 treatments, at the rate of 3 aquariums for each concentration for 3 periods 7, 14 and 21 days, with an *in vivo* control.

Figure 1. *Phragmites australis*

Water analysis

For the analysis of heavy metals in wastewater, atomic absorption spectrometry (SHIMADZU-AA-6200) was used. This analysis was carried out in the laboratory of sciences and techniques of water and the environment of the University Mohamed Cherif Messadia of Souk Ahras.

RESULTS AND DISCUSSIONS

After the analysis of the heavy metals in wastewater, the results obtained show a high concentration of Zn and a low concentration of Fe and Pb, while the Cu concentration is below the limit of detection (Figure 2).

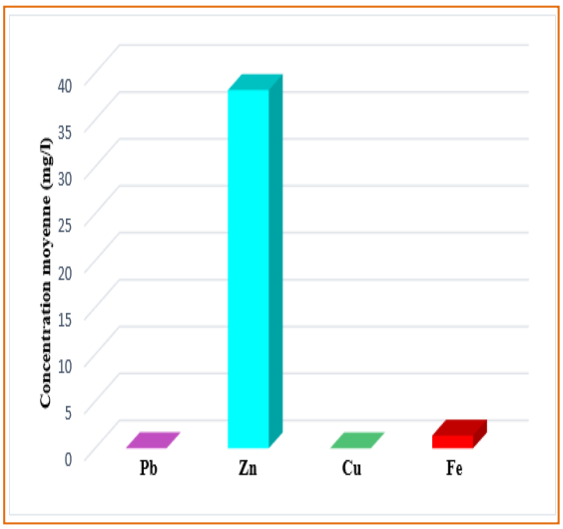
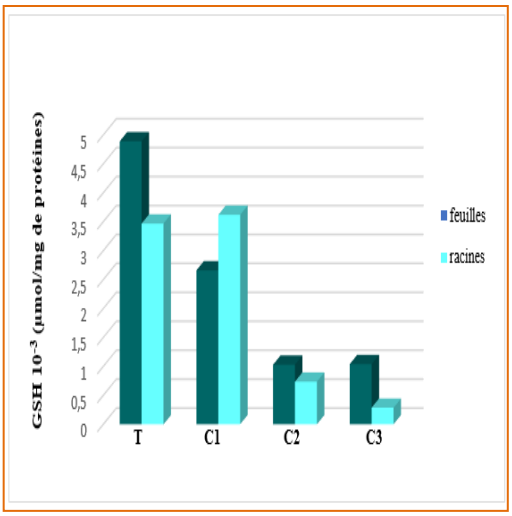


Figure 2. *Average concentrations of metallic elements in wastewater*

GSH activity

The non-enzymatic biomarker (GSH) assay of *P.Australis* showed no significant differences throughout treatment with (P> 0.05) .Figures 2 illustrate a decrease in GSH level at the foliar system level and root during the treatments of 7, 14, and 21 days, thus a decrease after 7 days for the doses 6 and 12 nmol / ml. These GSH level results reveal non-significant differences (P> 0.05).



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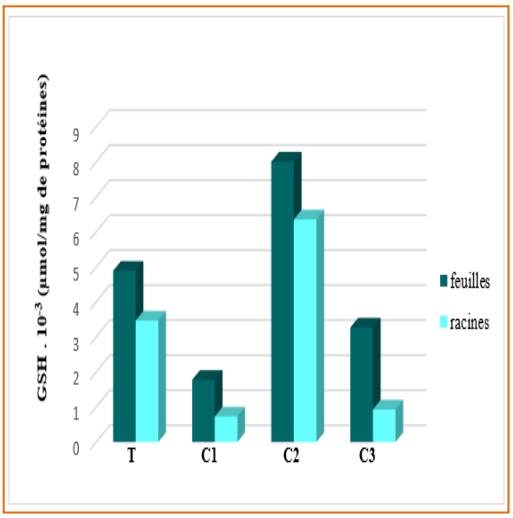

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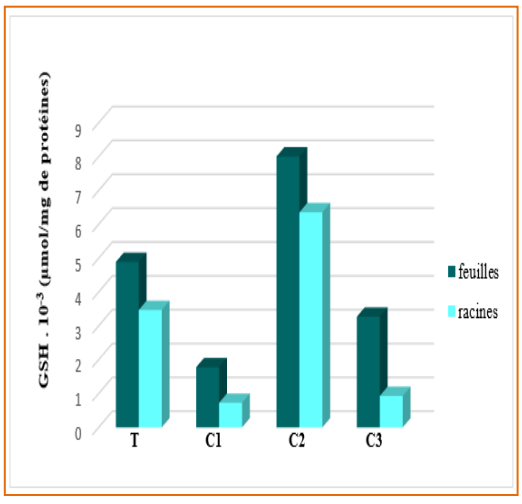

c

Figure 2. *Effect of ZnO on the non enzymatic activity of GSH of Phragmites australis (Kruskal Wallis test, ddl = 2 and n = 12). C: control, C1: 3, C2: 6, C3: 12 nmol ·mL^{-1}:*
(a) after 7 days; (b) after 14 days; (c) after 21 days of exposure

GSH is a substrate of seleno-dependent glutathione peroxidase (GPX). This antioxidant enzyme uses GSH as the main source of hydrogen [1]. These enzymes also catalyze the nucleophilic addition of the reduced glutathione thiol group (GSH) to electrophilic compounds, including intercellular metabolites to pollutants. It is an enzyme that catalyzes in the cytosol the conjugative reaction of electrophilic xenobiotics and their metabolites. with an endogenous ligand which is glutathione [2].

CONCLUSION

The different parameters measured for the raw waste water obviously indicate a significant metallic pollution by Zinc.
The results of non-enzymatic activities: glutathione (GSH), indicate a great antioxidative capacity of *Phragmites australis*. This activity may represent a response of these plants to oxidative stress probably caused by the accumulation of this xenobiotic at the cellular level.

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