

Phytoremediation with *Eichhornia crassipes* and *Cyperus papyrus* in the Llano Dam in the Municipality of Villa del Carbón, State of Mexico

Fitorremediación con *Eichhornia crassipes* y *Cyperus papyrus* en la Presa del Llano en el Municipio de Villa del Carbón, Estado de México

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Abstract

The Llano dam is a body of surface water that has been used as a source of water for irrigation and tourist activities such as rowing and fishing tournaments; This dam is located in the municipality of Villa del Carbón in the State of Mexico and there is a history of contamination by enterobacteria and phosphorus (Razo J. et al; 2016). Due to the mentioned importance of this body of water, the objective of this work was to carry out phytoremediation through the use of islands based on recyclable material (PET) and with the plant species *Eichhornia crassipes* and *Cyperus papyrus*. The phytoremediation evaluation was performed over a period of three months considering 3 arm, center and curtain sampling zones. The presence of enterobacteria was evaluated as indicators of microbiological contamination and in terms of physicochemical parameters, temperature, dissolved oxygen, pH, hardness, sulfates, nitrates and phosphates were evaluated. The microbiological results showed absence of enterobacteria in the central area of the body in the last sampling, it should be noted that the behavior of the physicochemical parameters is very variable, the values of nitrates and phosphates are related to the presence of enterobacteria, when modified it has an effect on the microorganisms mentioned above. It is important to note that the lack of environmental education in both site administrators and visitors affected the efficiency of the islands as they were moved to the banks of the dam reducing the contact of the phytoremediation islands with water.

Phytoremediation, Plain prey, Enterobacteria

Resumen

La presa del Llano es un cuerpo de agua superficial que ha sido utilizada como fuente de agua para riego y actividades turísticas como remo y torneos de pesca; dicha presa se encuentra ubicada en el municipio de Villa del Carbón en el Estado de México y existe antecedente de contaminación por enterobacterias y fósforo (Razo J. et al; 2016). Debido a la importancia mencionada de este cuerpo de agua el objetivo de este trabajo fue realizar fitorremediación mediante el uso de islas a base de material reciclable (PET) y con las especies vegetales *Eichhornia crassipes* y *Cyperus papyrus*. La evaluación de la fitorremediación se realizó en un periodo de tres meses considerando 3 zonas de muestreo brazo, centro y cortina. Se evaluó la presencia de enterobacterias como indicadores de contaminación microbológica y en cuanto a parámetros fisicoquímicos se evaluó la temperatura, oxígeno disuelto, pH, dureza, sulfatos, nitratos y fosfatos. Los resultados microbiológicos mostraron ausencia de enterobacterias en la zona centro del cuerpo en el último muestreo, cabe señalar que el comportamiento de los parámetros fisicoquímicos es muy variable, los valores de nitratos y fosfatos están relacionados con la presencia de enterobacterias, al modificarse tiene efecto sobre los microorganismos antes mencionados. Es importante señalar que la falta de educación ambiental tanto en los administradores del lugar como de los visitantes afectó la eficiencia de las islas ya que eran movidas a las orillas de la presa disminuyendo el contacto de las islas de fitorremediación con el agua.

Fitorremediación, Presa del llano, Enterobacterias

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Introduction

Three quarters of the Earth is covered by water, 97.5% is salty as part of seas and oceans, 2.5% is fresh water, of which only 0.3% is located in lakes and rivers where man takes most of the water he uses. , the rest is found in glaciers, polar ice caps and underground deposits. In Mexico there are more than 4,462 dams; 667 of them are considered large due to their storage capacity (INEGI, 2019). Mexico occupies the 35th place worldwide in storage capacity per capita (CNA, 2017).

The place of interest to study this work is the Llano dam, which is a body of surface water that has been used as a source of water for irrigation, fishing tournaments, etc. (Razo, J. et al 2016), this It is located in the municipality of Villa del Carbón in the state of Mexico. In 2016, this work group - Razo, J. and collaborators - conducted a study in this dam finding contamination by enterobacteria and for which water treatment was suggested to reduce pollution and so this dam will continue to be useful for the different activities in those that are realized; So then to your goal.

The useful technique that we consider can help decontaminate this body of water is phytoremediation, since it would be cheap, it would not impact the landscape value while they are being implemented in the dam and it is a technique reported as useful for different pollutants. Phytoremediation is a set of technologies that reduce in situ or ex situ the concentration of various compounds from biochemical processes carried out by the plants and microorganisms associated with them, removing, reducing, transforming, mineralizing, degrading, volatilizing or stabilizing pollutants (Kelley et al., 2000; Miretzky et al., 2004; Cherian and Oliveira, 2005; Eapen et al., 2007; Cho et al., 2008).

Of the plants used in phytoremediation, a wide diversity of species that are used for this purpose have been identified, among which we find *Eichhornia crassipes* and *Cyperus papyrus*, these species have been reported as efficient in reducing organic matter (Martelo, J. et to 2012). The objective of this work was to implement islands with *Eichhornia crassipes* and *Cyperus papyrus* for phytoremediation of the water of the Llano Dam in Villa del Carbón.

Methodology to be developed

ISLAND DESIGN: The following materials will be used for the design of the islands; plastic bottles (preferably of a single size), raffia for industrial use, fiberglass mesh, polyduct, silicone, plants (water lily and papyrus) that will absorb the contaminants. Figure 1,2 and 3. The dimensions and design of the island were made of an island size 2m x 2m, distributed in the areas as shown in figure 4



Figure 1 Phytoremediation Islands



Figure 2 Phytoremediation Islands



Figure 3 Phytoremediation Islands

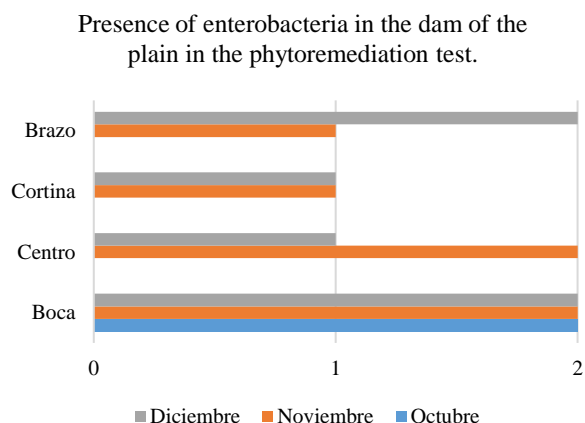


Figure 4 Distribution of the islands by INEGI zone

Results

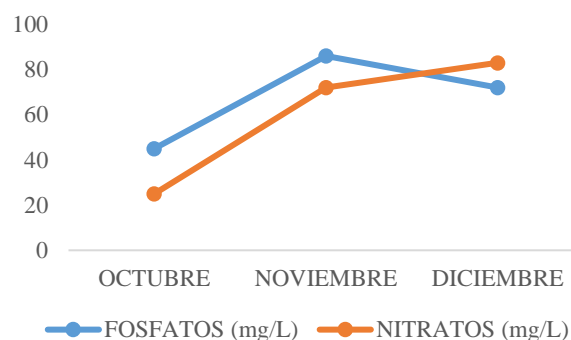
The results of the presence of enterobacteria at the 4 sampling points during the month of October, November and December, in which the islands were tried with *Eichhornia crassipes* and *Cyperus papyrus* for Phytoremediation are presented in figure 1. The bacteria were maintained. present throughout the sampling, coincides with the increase in phosphates and nitrates in those periods and sampling areas as can be seen in graph 2 of chemical parameters, phosphorus and nitrogen favor the growth of microorganisms acting as nutrients.

We believe that the lack of nutrient removal and the consequent permanence of bacteria in the body of study water could be affected because the islands did not remain floating, since each time the work area was visited they were on the banks and damaged (without plants) because visitors and even those in charge of the dam set aside the islands and showed disinterest in their objective affecting the phytoremediation process in the water.



Graphic 1 Enterobacteria by distribution zones

Physico-chemical parameters



Conclusions

Phytoremediation islands were implemented at the Llano Dam in Villa del Carbón in the State of Mexico. There was no decrease in enterobacteria and there were increases in nutrients such as phosphates and nitrates. We believe that the lack of participation of the community that uses the water resource could have an effect on the contact times of the islands with the water, affecting the phytoremediation process.

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