



Testing the efficiency of *Phragmitus australis* in reduce lead and cadmium chloride concentrations

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Abstract

The present study was conducted to determine the ability of *Phragmitus australis* plant to reduce the concentration of metals in its solutions, where *Phragmitus australis* plant was exposed to three different concentrations (10, 20, 30) ppm of Lead and Cadmium for 30 days. The results of the study showed an increase in the concentration of zinc and iron in *Phragmitus australis* tissues at the end of the study compared to the control.

Keywords: Heavy metals, physiological status, and response of aquatic plants

Introduction

Aquatic plants are of particular importance because of their fundamental role in influencing the aquatic ecosystem, in addition to the fact that most of them have many uses in industry and medicine, and humans may use them as food or fodder for their animals. Recently, they have become used in the field of treating environmental pollution, especially water pollution^[1]. Due to the diversity of aquatic plants and their wide spread in water bodies and their good tolerance to changing environmental conditions, different types of plant families have been used as biological evidence to study water pollution with heavy elements^[2]. They have also become widely used in the field of biological purification (Biofiltration) because of their ability to remove heavy elements from water and collect them in tissues. The process of using plants to remove pollutants from soil, groundwater, surface water and wastewater is called (Phytoremediation), as the biological processes of the plant help in the treatment process called (Green treatment)^[3]. The process of using plants in treatment is a new technique in removing pollutants due to the genetic, chemical and physiological properties of some plants that do not have harmful effects on the environment, unlike chemicals that are harmful to the environment when used in treating polluted water^[4]. There are many studies on aquatic plants that are used to remove various types of pollutants, especially heavy metals^[4]. The accumulation of some elements Cd, Cu, Fe, Mn, Pb, and Zn in the aquatic plant *Ceratophyllum demersum* has been studied. In another study, the aquatic plant *Ruppia maritima* growing in the Euphrates River was used to study the bioaccumulation of a number of heavy elements^[6]. The concentrations of Cd, Cu, Mn, Pb, and Zn were also studied in three plants: *Ceratophyllum demersum*, *Myriophyllum verticillatum*, and *Typha domingensis*. It was indicated that aquatic plants differ in their ability to accumulate heavy elements depending on the amount of these elements in the water, as well as the ability of their roots to penetrate the sediments, in addition to the vital processes in the plant body^[7].

Materials and methods

The experiment was conducted to test the ability of *Phragmitus australis* plant to reduce Lead and cadmium chloride concentration, by taking (50 g) of weight of plant. The plant were planted individually in (4) plastic containers with a volume of (10) liters. Each container contains (7) liters of chlorine-free water. Growth monitoring and

sampling continued for four weeks according to the required test, where plant samples were collected from the ponds every week for the purpose of estimating the concentrations of heavy metals in aquatic plant tissues and the removal rate of lead and cadmium chloride using a device Flame atomic spectrometer^[8].

Results & Discussion

The use of bioremediation technology using some aquatic plants has been found to create a healthy environment in economic ways, as this technology involves the efficiency of using aquatic plants to remove toxins or restrict the movement of heavy metals. The aim of this study was to use *Phragmitus australis*, which is one of the most widespread plants and one of the plants endemic to Iraqi aquatic systems, to know the extent of its efficiency in removing lead and cadmium from its aqueous solutions using phytoremediation technology^[9].

The results showed that *Phragmitus australis* was more accumulating the element Pb Figure (1) tissues compared to the element Cd Figure (2) This may be due to the fact that aquatic plants take heavy elements from sediments and water for the purpose of growth and development, and they also work to accumulate some toxic elements that have no importance in the plant, such as Cd, Pb^[10]. The *Phragmitus australis* plant can be used in phytoremediation, as a result of the ability of this plant to absorb and transport some elements such as Cd, Pb. These results agree with many researchers^[11] that present the tolerance of aquatic plants to different concentrations of heavy elements and their continued growth is the result of the possibility of a balance in the level of both enzymatic and molecular antioxidants such as peroxidase, proline, total phenols, etc., as well as the possibility of increasing the secretion of cellular metabolic products such as cysteine and glutamine. While^[12] indicated that plants, when absorbing heavy elements, stimulate the formation of plant compounds known as plant chelates that surround the atoms of polluting elements and retain them within vacuoles present in the cells of plant tissues, or through the plant and animal cell, which play an important role in removing toxicity by binding to the elements present in the cell. The accumulation of these elements in the target sites can be prevented and converted into inert forms (harmless salt crystals) and stored in insensitive sites such as vacuoles or converted into other non-toxic forms that can be distributed and used again in metabolic processes^[13].

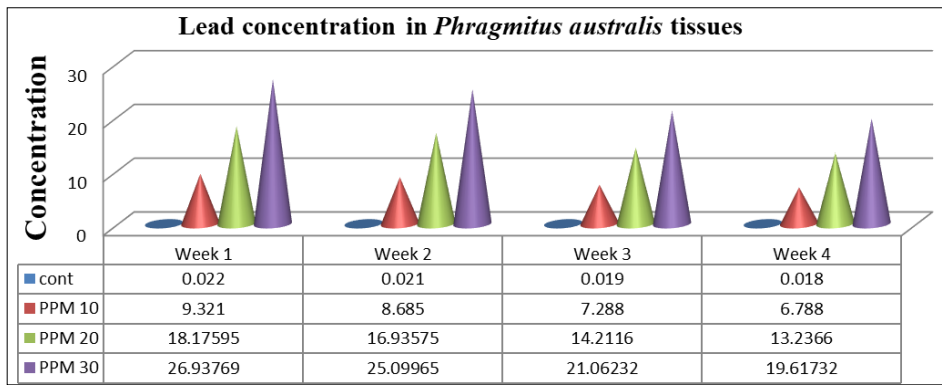


Fig 1: Variation in lead concentration during the experiment period in *Phragmites australis* tissues (mg/g dry weight)

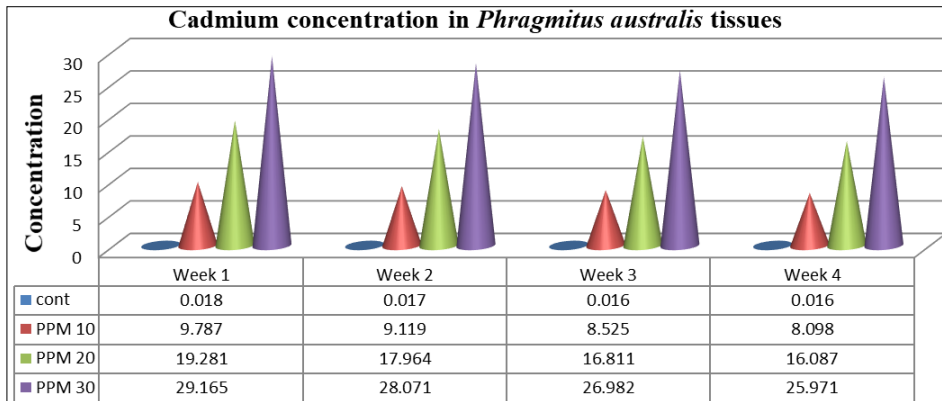


Fig 2: Variation in lead concentration during the experiment period in *Phragmites australis* tissues (mg/g dry weight)

The results showed that the highest removal rate of lead was at a concentration of 10 ppm compared to other concentrations as in Figure (3), and the highest removal rate of cadmium was at a concentration of 10 ppm also compared to other concentrations as in Figure (4), and the removal rate of lead was higher than cadmium by *Phragmites australis*, which means that plant tissues affect the adsorption and absorption processes and the ability of aquatic plants to accumulate heavy elements, which is consistent with [14]. It was found that the accumulation of heavy elements in plant tissues Bioaccumulation varies according to the difference in plant type, the physical and chemical properties of water and soil, and the specificity of absorption and transfer of elements, in addition to the difference in the physiological, chemical, and molecular mechanisms of the accumulation process. The ability of aquatic plants to accumulate heavy elements has helped them to be used in removing various environmental pollutants, including heavy elements [15]. The mechanism of

accumulation of elements within the plant body is that these toxic elements are linked to the cell walls in the roots or leaves, which prevents their transfer through the plant sap or are expelled by a special mechanism to insensitive sites in the cell or stored in the gaps [16]. This increase in the concentrations of elements in aquatic plants compared to what is in water is consistent with what was mentioned by [17], who studied the *Ceratophyllum dimerism*, the thousand-leaf *Myriophyllum verticillatum*, and the papyrus *Typha domingensis* plants. The accumulation of heavy elements in plant tissues (Bioaccumulation) varies according to the plant species, the physical and chemical properties of water and soil, and the specificity of the absorption and transfer of elements, in addition to the difference in the physiological, chemical, and molecular mechanism of the accumulation process [18]. Plant tissues are more ideal agents for representing pollution than water due to adsorption and absorption processes [19].

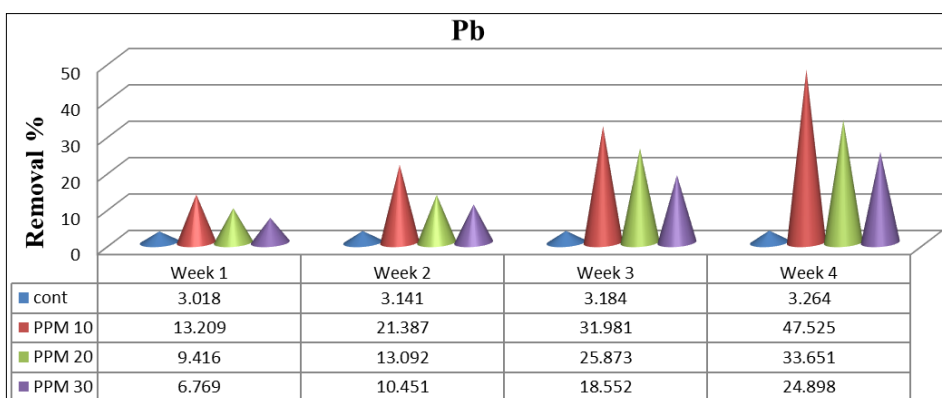


Fig 3: Percentage of removal lead from its aqueous solutions by the *Phragmites australis* plant

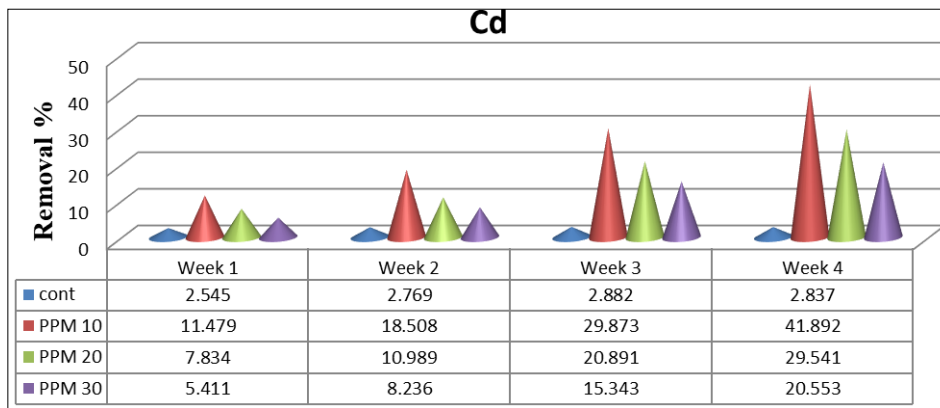


Fig 4: Percentage of removal of cadmium from its aqueous solutions by the *Phragmites australis* plant

Conclusion and Recommendations

We conclude from the current study that the plant *Phragmites australis* is more accumulating of lead than cadmium and also more removing of lead. Therefore, this plant can be used in phytoremediation processes to remove heavy elements.

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