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Testing the efficiency of *Phragmitus australis* in reduce zinc and manganese chlorides concentrations

Qassim Ammar Ahmood AL-Janabi, Hasan Ahmed Ali Albieg, Muhammad Abdul Hussein Kazem
Department of Environment, Collage of Environment Science, Al-Qasim Green University, Babylon, Iraq

Abstract
The purpose of this investigation was to ascertain whether Phragmitus australis might lower the metal concentration in its solutions. For 30 days, Phragmitus australis was subjected to three different zinc and manganese concentrations (10, 20, and 30 ppm). The study's findings demonstrated that, in comparison to the control group, Phragmitus australis tissues had higher concentrations of zinc and iron at the conclusion of the investigation.

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

Introduction

Because of their fundamental role in influencing the aquatic ecosystem, the fact that most aquatic plants have numerous uses in industry and medicine, the fact that humans can use them as food or animal fodder, and the fact that they have recently been used to treat environmental pollution, particularly water pollution, make aquatic plants especially important [1]. Different plant families have been employed as a biological reference to research water pollution with heavy metals because of the diversity of aquatic plants, their widespread distribution in water bodies, and their good tolerance to changing environmental conditions [2]. Because of their propensity to extract heavy minerals from water, they have also found extensive application in the field of biological purification, or bio-filtration. In order to remove contaminants from soil, groundwater, surface water, and wastewater, a technique known as "phytoremediation" is used, since plants' biological functions aid in the process of "green treatment" [3]. Because certain plants have physiological, chemical, and genetic characteristics that do not harm the environment—unlike chemicals, which are hazardous to the environment when used to treat contaminated water—using plants in treatment is thought to be a novel approach to eliminating pollutants [4]. Numerous studies have been done on aquatic plants that are utilized to remove various contaminants, particularly heavy metals [5]. Additionally, three plants—Ceratophyllum demersum, Myriophyllum verticillatum, and Typha domingenesis—had their Mn, Cu, Mn, Zn, and Zn concentrations examined. It has been shown that the capacity of aquatic plants to accumulate heavy elements varies according to the concentration of these elements in the water, the root system's ability to reach sediments, and the physiological functions of the plant body [6].

Materials and methods

Materials and Procedures: Using 50 g of plant weight, the experiment was designed to determine whether Phragmitus australis could lower the concentrations of Zinc and Manganese chloride. Each plant was planted separately in four ten-liter plastic containers. Seven liters of chlorine-free water are included in each container. In accordance with the necessary test, growth monitoring and sampling continued for four weeks. Plant samples were taken weekly from the ponds to estimate the concentrations of heavy metals in aquatic plant tissues and the rate at which Zinc and Manganese chloride were removed using a Flame atomic spectrometer [7].

Results & discussion

It has been discovered that applying bioremediation technology, which makes effective use of aquatic plants to eliminate pollutants or limit the flow of heavy metals, can economically contribute to the creation of a healthy environment. The purpose of this work was to determine the degree to which Phragmitus australis, one of the most common and endemic plants to Iraqi aquatic systems, can remove Zinc and Manganese from its aqueous solutions through the application of phytoremediation technology [8]. The results showed that Phragmitus australis was higher accumulating the element Zn Figure (1) tissues compared to the element Mn Figure (2) This could be because aquatic plants want to accumulate certain harmful elements, like Mn and Zn, that are unnecessary for the plant, while also taking up heavy elements from sediments and water for growth and development [9]. Because Phragmitus australis is capable of absorbing and transporting certain elements, such Zn and Mn, it can be used in phytoremediation. These findings support the findings of numerous researchers [10], who claim that the capacity to balance the levels of enzymatic and molecular antioxidants, such as peroxidase, proline, total phenols, etc., as well as the potential to increase the secretion of cellular metabolic products, such as cysteine and glutamine, is what allows aquatic plants to tolerate varying concentrations of heavy elements and continue to grow. While [11] noted that the absorption of heavy elements by plants results in the production of plant compounds known as plant chelates, which encircle and trap polluting element atoms within the vacuoles in plant tissues or through plant and animal cells. These compounds are crucial in eliminating toxicity because they bind to the elements already present in the cell and prevent their accumulation in the intended sites, converting them into inert forms (harmless salt crystals) that can be stored in non-sensitive locations like vacuoles or into other non-toxic forms that can be dispersed and utilized once more in metabolic processes [12].

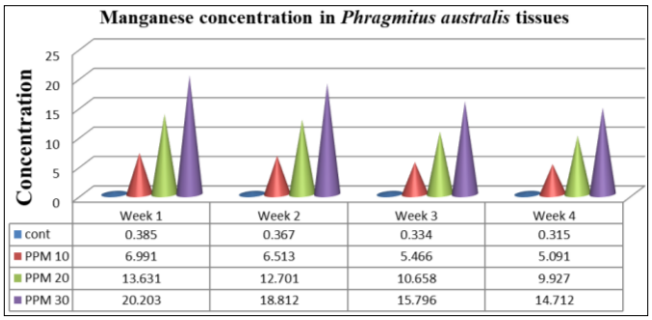

Fig 1: Variation in Manganese concentration during the experiment period in *Phragmitus australis* tissues (Mn/g dry weight)

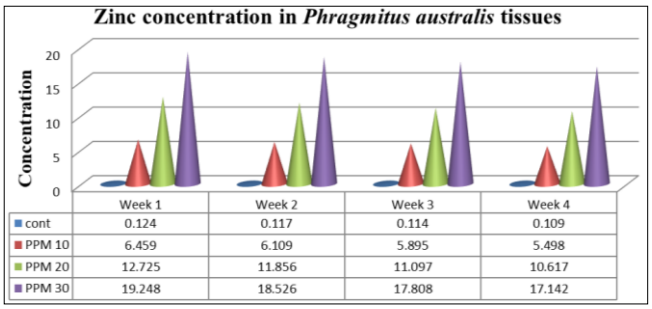

Fig 2: Variation in Zinc concentration during the experiment period in *Phragmitus australis* tissues (Mn/g dry weight)

The results showed that the highest removal rate of Zinc was at a concentration of 10 ppm compared to other concentrations as in Figure (3), and the highest removal rate of Manganese was at a concentration of 10 ppm also compared to other concentrations as in Figure (4), and the removal rate of Zinc was higher than Manganese by Phragmitus 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 [13]. 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 [14]. 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 [15]. This increase in the concentrations of elements in aquatic plants compared to what is in water is consistent with what was mentioned by [16], 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, Plant tissues are more ideal agents for representing pollution than water due to adsorption and absorption processes [17].

According to the results, the highest Zinc removal rate was observed at a concentration of 10 ppm in Figure (3), while the highest Manganese removal rate was observed at a concentration of 10 ppm in Figure (4). Phragmitus australis also removed more Zinc than Manganese, indicating that plant tissues influence the processes of adsorption and absorption as well as the capacity of aquatic plants to accumulate heavy elements. These findings are consistent with [14]. It was discovered that the bioaccumulation of heavy elements in plant tissues differs depending on the type of plant, the physical and chemical characteristics of the soil and water, the specificity of the element's absorption and transport, and the physiological, chemical, and molecular mechanisms underlying the accumulation process. Aquatic plants can amass heavy elements, which they can then use to remove other pollutants from the environment, including heavy elements [15]. A unique process either expels the poisonous elements to insensitive areas of the cell or stores them in vacuoles. This is how the components accumulate inside the plant body: the toxic elements bond to the cell walls in the roots or leaves, preventing their transfer through the plant sap [16]. According to [17], who examined the plants Ceratophyllum dimerism, Myriophyllum alphaleaf, and Papyrus Typha domingensis, there is an increase in the amounts of elements in aquatic plants when compared to what is found in water. The process of heavy element accumulation in plant tissues, known as bioaccumulation, is contingent upon several factors, including the type of plant, the physical and chemical characteristics of the soil and water, the specificity of element absorption and transport, and the physiological, chemical, and molecular mechanisms involved in the process [18]. Because of the processes of absorption and desorption, plant tissues are thought to be better than water at portraying pollution [19].

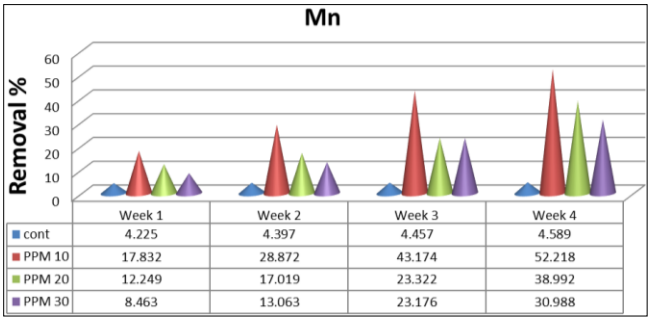

Fig 3: Percentage of removal Manganese from its aqueous solutions by the *Phragmitus australis* plant

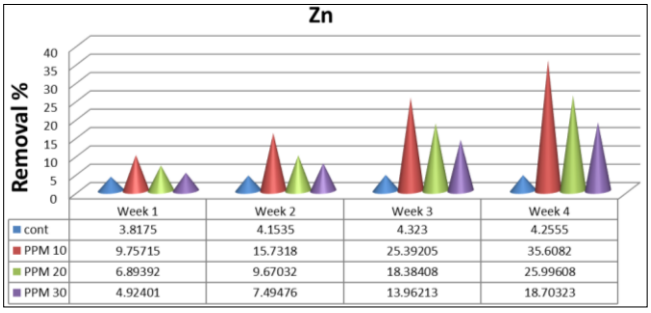

Fig 4: Percentage of removal of Zinc from its aqueous solutions by the *Phragmitus australis* plant

Conclusion and recommendations

Based on the current study, we can conclude that Phragmitus australis can be employed in phytoremediation procedures to remove heavy elements because it accumulates Zinc more than Manganese and removes Zinc more than Manganese.

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