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An environmental study to measure the focus of heavy elements in algae near the sewage stations in the Euphrates River

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Abstract
The accumulation of heavy metals (HMs) in algae within sewage stations in the Euphrates River is a concerning environmental issue. HMs are toxic substances that can have harmful effects on aquatic ecosystems and human health when they accumulate in high concentrations. Algae, as primary producers in aquatic environments, can absorb and accumulate HMs from the surrounding water. Hence, the present study focuses to analyze the HMs in water and three different algal species (*Chroococcus disperses, Spirogyra aequinoctialis* and *Oscillatoria tenuis*) in the sewage stations on the Euphrates River in Hillah Governorate. Results indicate the values of studied heavy metals in water at (the sewage stations in the Euphrates River) ranged from 1.32 to 8.67 mg/L. Cadmium had the greatest amount of metals in water (8.67 mg/l), while Chromium had the lowest level (1.32 mg/L). *Spirogyra aequinoctialis* was determined to have the highest arsenic level. *C. disperses* (12.3 µg/g/dwt) and *Oscillatoria tenuis* (46.3 µg/g/dwt). On the other hand, cadmium levels were reported to vary from 6.8 µg/g/dwt in *C. disperses* to 3.7 µg/g/dwt in *Oscillatoria tenuis*. Regarding zinc, Station had the greatest concentration of *O. tenuis* (103.1 µg/g/dwt). Chromium had the highest level of metals in *O. tenuis* (180.0 µg/g/dwt), while cadmium had the lowest level in *Oscillatoria tenuis* (3.7 µg/g/dwt). For lead highest level in *O. tenuis* (33.7 µg/g/dwt) and the lowest in *S. aequinoctialis* (16.7 µg/g/dwt So it's clear that the metal is absorbed by the algae. Therefor continued research on arsenic, cadmium, lead, zinc and chromium pollution, its sources, and its effects on the Euphrates River ecosystem is crucial for informed decision-making and effective mitigation strategies.

Keywords: Measure, focus, heavy elements, Euphrates river

Introduction

Human activities that result in pollution disturb the balance of aquatic ecosystems, dramatically negatively impacting the system. As a result of rising oxygen demand and nutrient loading caused by wastewater discharge from industries, aquatic systems are becoming unstable today (Morrison *et al*., 2001) [25]. Due to the growth of mining, smelting, and other industrial activities, HM discharges are one of the contaminants that harm the diversity of ecosystems. Even if some metals are needed as micronutrients, when their concentration is raised in an organism, most organisms become poisonous (Tangahu *et al*., 2011; Jaiswar *et al*., 2015) [22, 8]. The Euphrates River is one of the most historically significant rivers in the world. It flows through several countries in the Middle East, including Turkey, Syria, and Iraq. The river has played a crucial role in the development of human civilization, particularly in the ancient Mesopotamian region, often referred to as the "cradle of civilization." The Euphrates is approximately 1,740 miles (2,800 kilometers) long, making it one of the longest rivers in Western Asia. It originates in the mountains of eastern Turkey and flows south through Syria before entering Iraq and eventually joining the “Tigris River” to form the “Shatt Al Arab”, which then flows into the “Persian-Gulf”.

Several factors can contribute to the accumulation of HMs in algae within sewage stations in the Euphrates River. Industrial activities along the Euphrates River may release HMs into the water, which can then be taken up by algae. Sewage stations may also receive effluents from various industries, leading to the contamination of the water. Pesticides and fertilizers used in agricultural activities can contain HMs. Runoff from agricultural lands can carry these metals into the river, where they can be absorbed by algae (Gul *et al*., 2021; Pauzi *et al*., 2019) [7, 13].

Urban areas near the river can contribute to HM pollution through various means, such as storm water runoff from roads and buildings, improper waste disposal, and industrial discharges. Natural weathering of rocks and minerals in the river basin can release trace amounts of HMs into the water, which can accumulate over time (Gul *et al.*, 2020) [6]. Therefore, it is imperative to closely observe and regulate the concentrations of these substances in water bodies while advancing wastewater purification technologies.

Materials and Methods

Sewage stations are facilities designed to treat and manage wastewater and sewage before it is released back into the environment. A total 15 samples were collected. It's important to note that the management of sewage and wastewater is a critical aspect of environmental conservation and public health, especially in regions where water resources like rivers are essential for various purposes, including agriculture, drinking water, and industry. From the sewage station in the Euphrates River, the *Chroococcus disperses*, *Spirogyra aequinoctialis*, and *Oscillatoria tenuis* were collected with the help of forceps. The algae were thoroughly Wash twice with tap water and once with distilled water to remove stuck foreign matter such as sand and dirt. A (Blue-green) Medium (BG 11 medium) was added to conical flasks with the collected materials (Rippka *et al.*, 1979) [18]. After 24 hours of air drying, the cleaned biomass was dried in an oven set to 80 °C until a steady weight could be measured. After being pulverized, Pass the dried biomass through a 2 mm sieve and store it in a polyethylene bottle.

The known amounts of Cd, Zn, As, Cr, and Pb are contained in 250 ml Erlenmeyer glass flasks as aqueous solutions, with 20, 40, 60, and 80 mg-1 concentrations. Each flask was filled with 250 mg of accurately measured biomass, and the mixture was stirred on a rotary shaker at 180 rpm for different times (30, 60, 90, and 120 min). For each concentration, maintain a control without heavy metals (HMs). Following the corresponding campaigning period, the solutions were filtered to remove the biomass and underwent further testing. To support the findings, each biosorption experiment was carried out three times. The information displayed is the average result of these repeated analyses. HM concentrations in all filtrates were measured using inductively coupled plasma-optical emission spectroscopy (ICP-OES, Perkin Elmer Optima-3300 RL) (Shaik *et al.*, 2006) [19].

Results and Discussion

Tables 1 and Figures 1-4 reflect the findings of the HM levels in the water and the organisms examined. According to Table 1, the concentrations of HMs in the water at Station (the sewage stations in the Euphrates River) ranged from 1.32 to 8.67 mg/l. cadmium had the highest level of metals in water (8.67 mg/l), while chromium had the lowest level (1.32 mg/l). Cadmium was once again detected at the maximum level and chromium at the minimum level. Figure 1 shows the level of heavy metals in water.

Table 1: HMs Station water and biological concentration (The sewage stations in the Euphrates River)

Heavy Metals	Water (mg/l)	*O. tenuis* (µg/g/dwt)	*S. aequinoctialis* (µg/g/dwt)	*C. disperses* (µg/g/dwt)
As	3.59	46.3	52.4	12.3
Cd	8.67	3.7	4.2	6.8
Pb	2.12	33.7	16.7	31.7
Zn	1.89	103.1	87.5	69.3
Cr	1.32	180.0	173.1	151.5

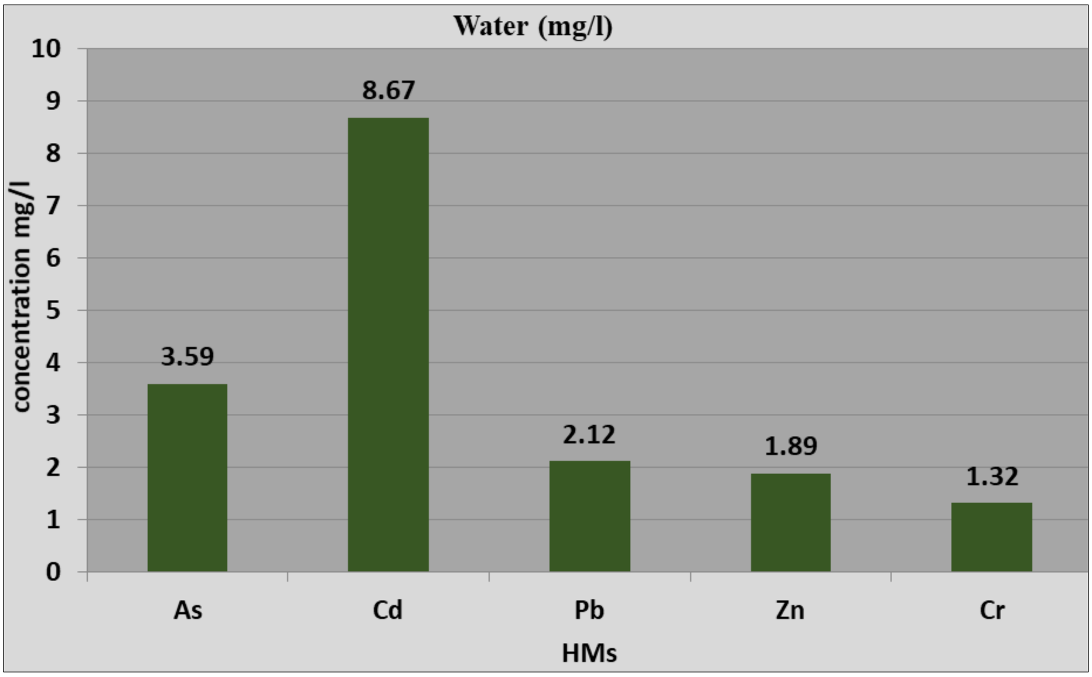

Fig 1: Shows the HMs in water (mg/L)

Figure 2 shows the amount of HMs in the algae (*O. tenuis*) at Station ranged from 3.7 to 180 µg/g/dwt. Chromium had the highest level of metals, while Cadmium had the lowest level (3.7 µg/g/dwt).

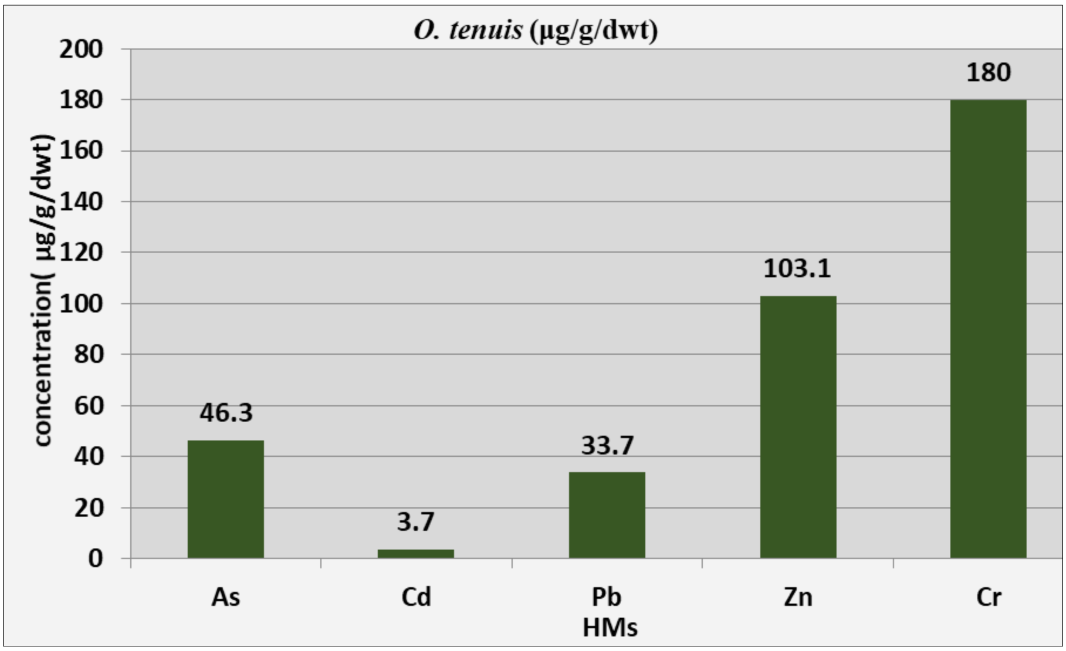

Fig 2: Shows the HMs in *O. tenuis* (µg/g/dwt)

According to Figure 3 *S. aequinoctialis* was determined to have the highest Chromium level. On the other hand, cadmium levels were reported to range from 4.2 µg/g/dwt in *S. aequinoctialis*.

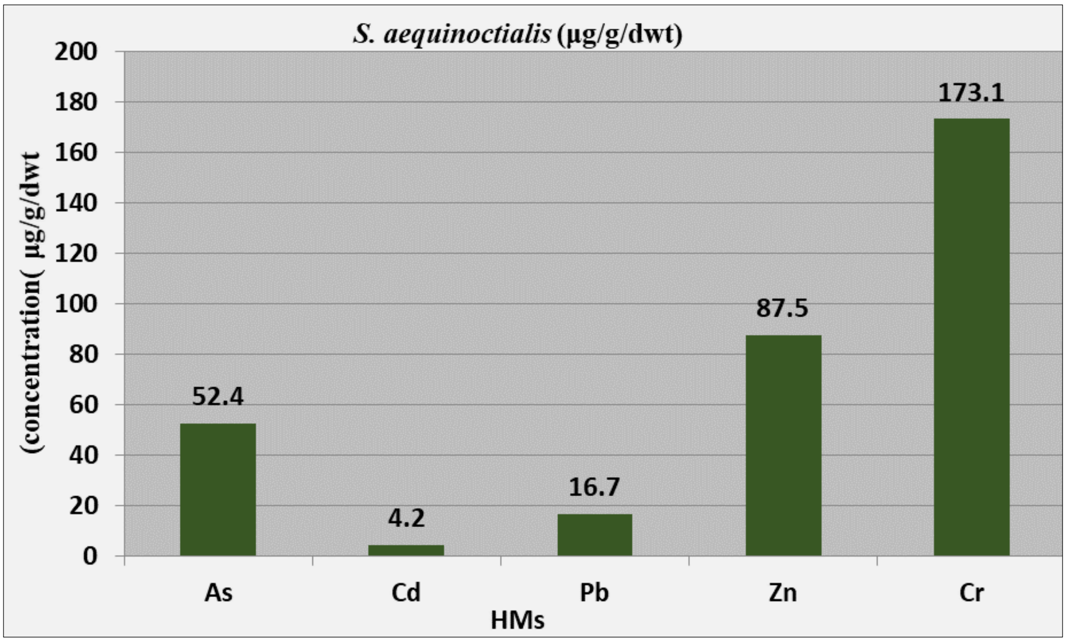

Fig 3: Shows the HMs in *S. aequinoctialis* (µg/g/dwt)

Figure 4, shows the amount of HMs in the algae (*C. disperses*) at Station ranged from 6.8 to 151.5 µg/g/dwt. Chromium had the highest level of metals, while Cadmium had the lowest level (3.7 µg/g/dwt).

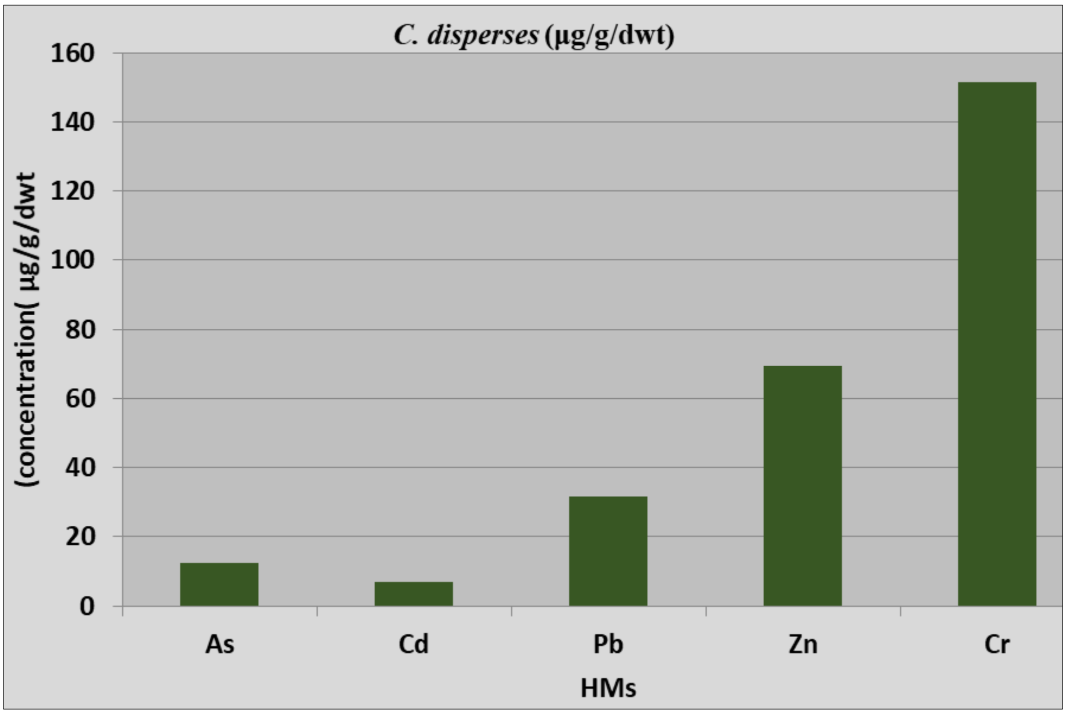

Fig 4: Shows the HMs in *C. disperses* (µg/g/dwt)

Regarding zinc, Stations had the highest concentration of *O. tenuis* (103.1 µg/g/dwt). A literature review reveals that Sreenivasan (1968) [21] found no iron in Chengleput Pond, although he found 2 mg/l Located at Erghad and Ooty Lakes (Sreenivasan, 1964) [20]. Malarvizhi (1989) [12] did note the highest zinc levels in Manur Pond, which were 37.46 mg/l. As a result, the present study found values similar to those of the present study. However, according to Wetzel (1980) [24], the average total zinc concentration in alkaline or typical lakes ranges from 50 to 200 mg/l. At the same time, Chatterg (2010) [2] measured Copper content in water increased to 3.95 mg/l in the Damodar River. When these levels are compared to those in the current study, it becomes clear that they are comparable. For instance, Malarvizhi (1989) [12] reported Pb levels in water to be as high as 5.8 mg/l, Ustanada (2011) Reporting values as high as 5.24 mg/L, Janwar *et al*. (2015) reported concentrations as high as 40.47 mg/L in the West Hall tributary. Govindasamy (2007) [5] found the level in Palar river to be 13.0 mg/L. These values are relatively low compared with those determined in the current study. Malarvzhi (1989) [12] measured zinc value as 15.16 mg/l, Govindasamy (2007) [5] measured 40.5 mg/l, Janwar *et al*. (2015) measured 6.24 mg/L. These values are similar to those obtained in the current study.

Rai *et al*. (2008) [16] documented the accumulation of Cu in Oedogonium at a concentration of 17.78 µg/g. Similarly, Al-Homaidan *et al*. (2011) [11] investigated the accumulation of Cladophora in a stream in Riyadh, finding a concentration of 138.28 µg/g. However, Janwar (2015) found a 22.11 µg/g level in the same species, contrary to Rajfur *et al*.'s (2011) [17] claim of a copper level of 47.5 µg/g in a Polish river. Compared to the current study, these amounts of accumulation by algae are on the lower end of the copper absorption spectrum. Oedogonium had a Cd level of 21.10 µg/g, and Cladophora had a level of 4.14 µg/g, according to Rajfur *et al*.'s (2011) [17] research. On the other hand, Al-Homaidan *et al*. (2011) [11] measured Cd levels at 1.08 µg/g. While Janwar *et al*. (2015) found 9.23 µg/g values in Spirogyra, Rajfur *et al*. (2011) [17] observed 108.5 µg/g levels in Spirogyra. The amounts of Spirogyra attained in the current investigation are within the range described by other researchers. Eva and Jan (2001) [4] measured the concentration of Pb in Cladophora from the Danube River at 7.9 µg/g, Dwivedi *et al*. (2006) [3] measured it in Oscillatoria at 142.81 µg/g, and Janwar (2015) measured it in Cladophora at 51.50 µg. The results for oscillatoria in the current study are subpar compared to those of other studies. Regarding zinc, Javed (2006) [10] observed that 290.13 µg/g of zinc accumulated in plankton, whereas Lokeshwari and Chandrappa (2007) [11] found 82.0 µg/g of zinc in weed plants. While Jaiswar (2015) [8] observed 210.26 µg/g in Oscillatoria and 191.59 µg/g in Oedogonium. Figure 3: Shows the HMs in *Spirogyra aequinoctialis* (µg/g/dwt)

Dwivedi (2006) [3] showed zinc to accumulate 277 µg/g in Oscillatoria. The current zinc level in *C. disperses* found in this study is significantly lower than others. The values at Station (the sewage stations in the Euphrates River) ranged from 1.32 to 8.67 mg/L. cadmium had the greatest amount of metals in water (8.67 mg/l), while Chromium had the lowest level (1.32 mg/L). Cadmium was once more detected at the maximum level and chromium at the minimum level. The amount of HMs in the algae at Station ranged from 12.3 to 52.4 µg/g/dwt for arsenic. *S. aequinoctialis* was determined to have the highest arsenic level. *C. disperses* (12.3 µg/g/dwt) and *O. tenuis* (46.3 µg/g/dwt) were the other two species that produced significant findings. On the other hand, cadmium levels were reported to vary from 6.8 µg/g/dwt in C. disperses to 3.7 µg/g/dwt in *O. tenuis* and 4.2 µg/g/dwt in *S. aequinoctialis*.

Addressing HM accumulation in algae within sewage stations in the Euphrates River requires a comprehensive approach. Governments and regulatory bodies should establish and enforce strict guidelines for industrial discharges and wastewater treatment to limit HM pollution (Rahim *et al*., 2019; Jan *et al*., 2023) [14, 9]. Improved sewage treatment processes can help remove HMs from wastewater before it is released into the river. Promoting sustainable and responsible agricultural practices can help reduce the use of HM-containing inputs and minimize runoff. Raising awareness among the public about the impacts of HM pollution and encouraging responsible waste disposal practices can contribute to reducing pollution at the source (Rahim *et al*., 2019; Zareef *et al*., 2023) [14, 23]. It's important for relevant authorities, environmental organizations, and communities to work together to address this issue and protect the health of the Euphrates River and its surrounding ecosystems.

Conclusion

Therefore, the primary objective of this study is to examine the presence of HMs in water samples collected from sewage stations located along the Euphrates River, as well as to analyse the concentrations of these metals in three distinct algae species, namely *C. disperses*, *S. aequinoctialis*, and *O. tenuis.* The findings of the study reveal that chromium exhibited the highest levels of metal content, followed by zinc, arsenic, lead, and cadmium in organisms. Among the studied organisms, *C. disperses* displayed the lowest metal content. Hence, it is evident that algae exhibit the capacity to uptake metals. High concentrations of HMs can disrupt aquatic ecosystems by affecting the growth and health of algae and other aquatic organisms. This disruption can have cascading effects on the entire food web. If these algae enter the human food chain (e.g., through fish consumption), HMs can pose health risks to humans. Some HMs, such as lead, cadmium, and mercury, are known to cause a range of health problems, including neurological, renal, and developmental issues. HM contamination can degrade water quality, making it unsafe for both aquatic life and human use, such as drinking water and irrigation.

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