



Accumulation of copper metal from waste water by using *Ceratophyllum demersum* L. (hornwort)



Ceratophyllum demersum L. (tilki kuyruğu) bitkisi kullanılarak atıksulardan bakır metalinin akümülyasyonu

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ABSTRACT

In this study, the bioaccumulation sufficiency of plant *Ceratophyllum submersum* L. which is distributed in aquatic ecosystems against toxic metal ion was tested. In laboratory condition, plant was exposed to prepared stock solution of copper metal 1,0; 3,0;5,0; 5,0 and 7,0 mg/L concentration metal solutions in certain periods (24, 48, and 72 hours) and changing amount of accumulation of plants in depending on time and concentration was measured by atomic absorption spectrometer. The minimum uptake at 2.2 g fresh weight and 0.1 ppm concentration of copper metal was 4.54 µg/g of copper after 24 hours. And the maximum uptake at 1.8 g fresh weight and 4.0 ppm concentration was 92.13 µg/g after 48 hours. The minimum uptake at 2.2 g fresh weight plant exposed to 0.1 ppm concentration of Cu+2 solution after 24 hours, the plant uptake was 4.54 µg/g Cu+2. The maximum uptake at 1.8 g fresh weight plant exposed to 4.0 ppm concentration Cu+2 solution after 48 hours, the plant uptake was 92.13 µg/g Cu+2.

Keywords: Accumulation, *Ceratophyllum demersum*, Copper, Heavy metal

ÖZET

Bu çalışmada toksik metal iyonu olan bakır ağır metalinin sucul ekosistemlerde yayılış gösteren *Ceratophyllum submersum* bitkisinin değişen zamana ve konsantrasyona bağlı biyo akümülyasyon yeterlilikleri test edilmiştir. Bitkiler laboratuvar şartlarında bakır metalinin stok solüsyonlarından 1,0,3,0,5,0 ve 7,0 mg/L konsantrasyonlarda hazırlanan metal çözeltisiyle, belli zaman periyodlarında (24, 48 ve 72 saat) muamele edilmiştir. Veriler değerlendirildiğinde bitkinin farklı konsantrasyonlarda bakırın farklı sürelerde akümüle ettiği atomic absorpsiyon spektrofotometresiyle ölçülmüştür. Minimum uzaklaştırma 2,2 g taze ağırlıkta 0,1 ppm konsantrasyonda bakır metali, 24 saat sonra 4,54 µg/g bakır ortamdan uzaklaştırılmaktadır. Maksimum uzaklaştırma 48 saat sonra 4,0 ppm de 1,8 g ağırlıkta yaş bitkiyle 92,13 µg/g.

Anahtar sözcükler: Akümülyasyon, *Ceratophyllum demersum*, Bakır, Ağır metal

1. Introduction

Environmental problems are among the most important dangers threatening the health of plants and the balance of nature. Heavy metals consist of other wastes are more important among other chemical pollutants according to various sources[1]. To tackle with issue, many plants are used. Plants can take up accumulate metals from water, atmosphere and soil[2].

Plants known as hyperaccumulators uptake hundred times more heavy metals than normal plants [3]. These plants called hyperaccumulators have capacity to survive in environments with high metal concentrations. Recent various methods have been used to uptake metallic pollutants from water. The uptake of metallic pollutants from waters by macroalgae has been proved worked [4]. In this study, the accumulation sufficiency of the plants of *Ceratophyllum demersum*, which are distributed in aquatic ecosystems against Cu⁺² metal ions, was tested.

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2. Material and Methods

Ceratophyllum demersum L. (Hornwort), which absorbs copper metals in water, has been used as research material. This aquatic plant was received from the Işıklı Lake, Denizli City, Turkey. General structure of the plant is seen in materials washed firmly and ruined indistilled water 3 times for 5 minute. Working metal and standard solutions with different concentrations (0.1, 0.3, 0.5, 1.0, 2.0, 3.0, 4.0, 5.0 mg/L) of each metal were prepared by diluting the stock solution (1000 mg/L Merck, Italy) using deionized water. Control samples have been prepared with the same method. Plants have been selected at equal weight. *Ceratophyllum demersum* L. was inoculated with medium containing various concentrations of Cu^{+2} and exposures for 24, 48 and 72 hours. Metal contents of the plant samples were determined using an Atomic Absorption Spectrophotometer (AAS 700, Perkin-Elmer). All experiments were carried out repetitively and the results were calculated using the $C = K \cdot N \cdot \text{Abs} - B$ formula

$K=34.744$, $B=0.0214$ ($C = y = \text{Concentration}$, $K=M=\text{Constant coefficients}$, $n = B = \text{Constant coefficients}$).

3. Results and Discussion

The results have been compared with those for the different aquatic plants. The levels accumulation heavy

metals in plant vary various species and different aquatic environment. In the laboratory conditions, the aquatic plant Hornwort was exposed to copper concentrations and at different time periods. Finally, our experiments showed that this plant accumulated at high levels of Cu^{+2} in the first few days and then showed a decrease in the accumulation may be due to reaching its saturation level. In research, we have chosen *Ceratophyllum demersum* for the accumulation of copper metal (Table1).

According to Table1, when 2.2 g fresh weight plant exposed to 0.1 ppm concentration of Cu^{+2} solution, after 24 hours, the plant uptake was 4.54g Cu^{+2} . When the fresh weight plant was exposed to different concentration of Cu^{+2} solution (0.1,0.3, 0.5, 1.0, 2.0, 3.0,4.0,5.0 mg/L), to uptake of the Cu^{+2} concentration was increased depending on time and exposure concentration at 24 hours the plant uptakes were 38.46 and 65.20 g/g Cu^{+2} respectively. For instance; when 1.3g fresh weight plant was exposed the 1.0ppm concentration of copper solution at different times (24, 48, and 72 hours), the plant uptakes were 65.20, 73.2, and 76.92 g/g Cu^{+2} respectively. Earlier studies have been shown that submerged plants have more accumulating capacity than floating or emergent ones[5,8]. Aquatic plants are not same effective for accumulation of heavy metals. *Elodea canadensis*, *Ceratophyllum demersum* have been found suitable for the uptake of different metals[9].

Table 1: The accumulation rates of copper heavy metals by *Ceratophyllum demersum* L. at different periods.

Hour	Wet weight (g)	Concentration (mg/L)	Standard absorbance (mg/L)	Sample absorbance (mg/L)	Rates of Cu^{2+} taken by plant ($\mu\text{g/g}$)
24	2.2	0.1	0.003	0.002	4.54
24	1.5	0.3	0.006	0.004	20.00
24	1.3	0.5	0.012	0.005	38.46
24	1.3	1.0	0.038	0.006	65.20
24	2.3	2.0	0.053	0.017	77.31
24	1.5	3.0	0.080	0.025	65.77
24	1.9	4.0	0.120	0.070	88.17
24	1.8	5.0	0.250	0.095	31.23
48	1.3	1.0	0.038	0.003	73.20
48	2.3	2.0	0.053	0.012	81.84
48	1.5	3.0	0.080	0.010	90.9
48	1.8	4.0	0.120	0.055	92.13
48	1.9	5.0	0.130	0.087	88.02
72	1.3	1.0	0.018	0.001	76.92
72	2.3	2.0	0.037	0.008	86.95
72	1.5	3.0	0.056	0.004	73.22
72	1.9	4.0	0.120	0.022	65.35
72	1.8	5.0	0.250	0.035	52.78

Typha species are among the most effective plant species. For example; *Typha angustifolia* L., *Typha domingensis*, *Typha latifolia* show potential to remove contaminants including heavy metals from wastewater [10]. In this study, copper heavy metal in water were tried to be removed from the media through *C. demersum* plant, abiding by different durations and concentrations. As result of data evaluation, it was found out that copper material was accumulated in different rates by *C. demersum* depending on time and concentration.

4. Conclusion

In this research *C. demersum* was used as absorbent for Cu^{+2} removal from wastewater. Our result conforms to the earlier reports on metal accumulation potential of aquatic plants. *C. demersum* is a good biosorbent for purification of wastewaters which include low percentage of Cu^{+2} metals.

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