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Bioaccumulation of Trace metals by aquatic plants

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Abstract: Acquatic plants play important roles in balancing water bodies. They are capable of acquiring large quantities of trace elements and heavy metals. The uptake of trace elements is often increased when plants are grown in effluent water containing high levels of macronutrients. Heavy metals enter surface and groundwater in various ways and adversely affect flora and fauna have capacity. The objective of the study is to evaluate the usefulness of different macrophytic species in reducing the nutrient content of the water *i.e.* to reduce the pollution level of water. Under present investigation *Hydrilla vercillata* Casp., Elodea (*Elodea canadensis* Rich); *Salvinia* sp., have been tested for removal of three important heavy metals Iron (Fe) , Copper(Cu) and Nickel (Ni) from metal solution. These species were grown at 5 mg/L concentrations of Fe , Cu and Ni in single metal solution. These plants have performed extremely well in removing the Fe, Cu, and Ni from their solution and were capable of removing up to 98% of Fe , 95% of Copper and 90 % of Nickel during 10 days dosimetry. Results indicated that at 5 mg/l of heavy metal concentration of Iron, the plant growth was normal and removal efficiency was greater. Removal of Iron for the period of ten days dosimetry was found harmless, without any symptom of toxicity in all the three plants . But in case of Copper and Nickel, all the plants have shown some morphological symptoms of toxicity after 5 days of dosimetry. And *Salvinia* sp., is capable in improving water quality to the maximum extent by reducing nutrient concentration.
Keywords: Aquatic macrophytes; *Hydrilla vercillata* Casp.,; elodea (*Elodea canadensis* Rich); *Salvinia* sp., Phytoremediation; Biochemical; Heavy metals.

Introduction

However, excessive accumulation of these heavy metals can be toxicto most plants. The ability to both tolerate elevated levels of heavy metals and accumulate them in very high concentrations has been evolved both independently and together in number of different plant species [1-3]. Eutrophication of a water body signifies the aging of a lake. It is caused by the accumulation of nutrients, sediments, silt and organic matter in the lake from the surrounding watershed. Macrophytic vegetation plays an important role in maintaining the ecosystem of a lake. Various types of macrophytes emergent, free floating, submerged are generally observed in an aquatic ecosystem. Free floating macrophytes leaves & roots are not attached in sediments. Aquatic plants have tremendous capacity of absorbing nutrients and other substances from the water and hence brings down the pollution load . The purpose of the study is to utilize these macrophytes as bio-filters and to observe efficiency of various macrophytes to remove pollutants available in ponds.[4]

Materials and Methods

The submerged macrophytes *Hydrilla vercillata* Casp., elodea (*Elodea canadensis* Rich.) and free floating *Salvinia* sp. were collected from nearby natural ponds in Mandya District. Plants were acclimatized for 5 days in fresh water holding tanks. After acclimatization, both plants were tested for the desired concentrations (5mg/L) of Iron , copper and Nickel for a detention time of 10 days. Triplicate batch tests were conducted in plastic tubs of 2.5-lt. capacity. Desired heavy metal concentration was added in each tub from prepared stock solution. About 15 plants of *Salvinia* and about 50 cm of *Hydrilla and* elodea (*Elodea canadensis* Rich.) were kept in each tub, and

marked the water level. All tubs were exposed enough light for detention time of 10 days. Everyday aged tap water added to maintain the same level in each tub. The aquatic plant was exposed separately to the individual metal ion solutions of copper ($CuSO_4.5H_2O$) , Iron ($FeSO_4$) and nickel ($NiCl_2.6H_2O$) at 5mg/L concentrations The water samples were taken to analysis for decrease in concentration at 24 hours intervals for 10 days using by an Atomic Absorption Spectrophotometer Shimadzu Model.[5-8]

Results and Discussion

Studies on biosorption of Iron , Copper and Nickel from contaminated water by *Hydrilla ,* elodea (*Elodea canadensis* Rich.) and *Salvinia* were conducted for a period of 10 days at 5mg/L concentration. The average daily removal of heavy metals by the acquatic plants is presented in Table-1. And percentage removal of Heavy metals at every 24-hrs interval is presented in Table-2. . Daily removal percentage of desired heavy metals by *Hydrilla vercillata* Casp., *Elodea canadensis Rich* , *Salvinia.* sp., Hydrilla is represented in Figure 1,2and 3.The results clearly suggested that at lower concentrations the plant growth was normal with greater removal efficiency. Maximum percentage removal of Copper and Nickel from wastewater was noticed on the 10th day of dosimetry[9]. The maximum percentage removal of 94.4% was recorded for Iron in *Elodea canadensis Rich,* eighth day of its dosimetry. For Copper and Nickel, the maximum percentage removals were observed on 10th day of dosimetry. But after seventh day, the plants started showing morphological changes in case of Copper and Nickel.[10,11] The maximum biosorption observed in ***Iron*** *:-Hydrilla vercillata* Casp.,91.2 %(5 days), *Elodea canadensis Rich* 94.4 % (8 days), *Salvinia.* sp.,88.8 % (ten days), **Copper**:- *Hydrilla vercillata* Casp.,89.2 %(10 days), *Elodea canadensis Rich* 86.4 (10 days), *Salvinia.* sp.,67 (ten days) and in **Nickel** :- *Hydrilla vercillata* Casp.,83 %(10 days), *Elodea canadensis Rich* 75 (10 days), *Salvinia.* sp.,40.4 (ten days).

Conclusion

Contamination of the aquatic bodies by various pollutants (both synthetics and organic) such as pesticides, Poly Aromatic Hydrocarbons , heavy metals, etc., have caused imbalance in the natural functioning of the ecosystem. Phytoremediation works best at sites with low to medium amount of pollution, and at sites contaminated with metals. With this special characteristics of aquatic plants, these can be employed easily for cost effective and eco-friendly technology in pollution abatement programs.

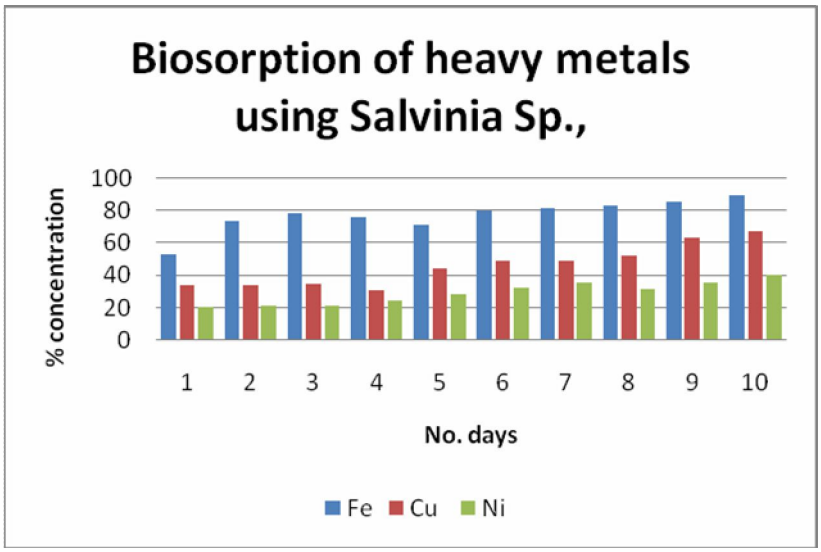
Table -1 Concentration of Iron, Copper and Nickel remaining in water after bio sorption of aquatic plants

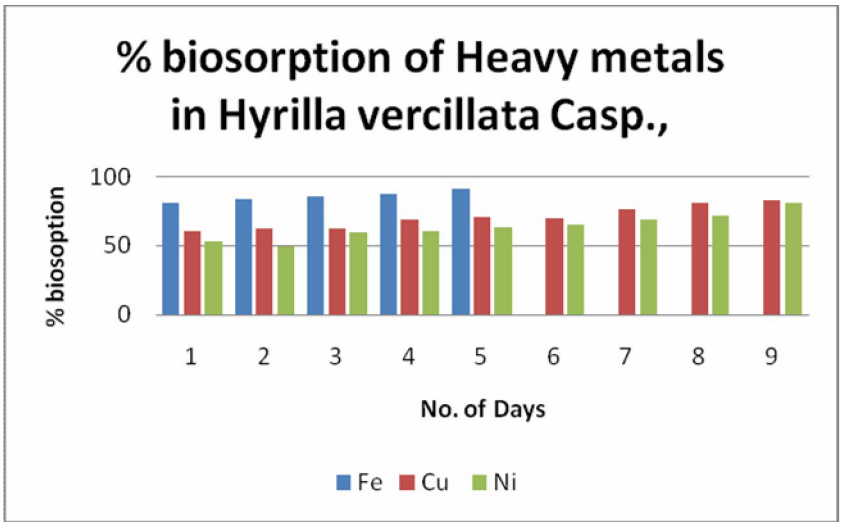
No. Of days	Hydrilla vercillata Casp.,			Elodea canadensis Rich			Salvinia. sp.,		
	Concentration of Heavy metal remaining in water in mgL^{-1}								
Heavy metals	Fe	Cu	Ni	Fe	Cu	Ni	Fe	Cu	Ni
1	0.99	1.97	2.35	1.25	2.25	3.10	2.35	3.32	3.97
2	0.85	1.90	2.55	0.95	1.99	3.05	1.35	3.30	3.95
3	0.76	1.88	2.05	0.8	1.98	2.95	1.12	3.26	3.95
4	0.65	1.56	1.99	0.69	1.85	2.89	1.22	3.45	3.79
5	0.44	1.47	1.85	0.47	1.64	2.45	1.45	2.78	3.57
6	-	1.55	1.76	0.35	1.56	2.23	1.04	2..56	3.37
7	-	1.2	1.56	0.30	1.25	2.05	0.96	2.55	3.24
8	-	0.95	1.44	0.28	0.95	188	0.85	2.42	3.42
9	-	82.8	80.2	-	83.4	64.8	85	62.6	35.4
10	-	89.2	83	-	86.4	75	88.8	67	40.4

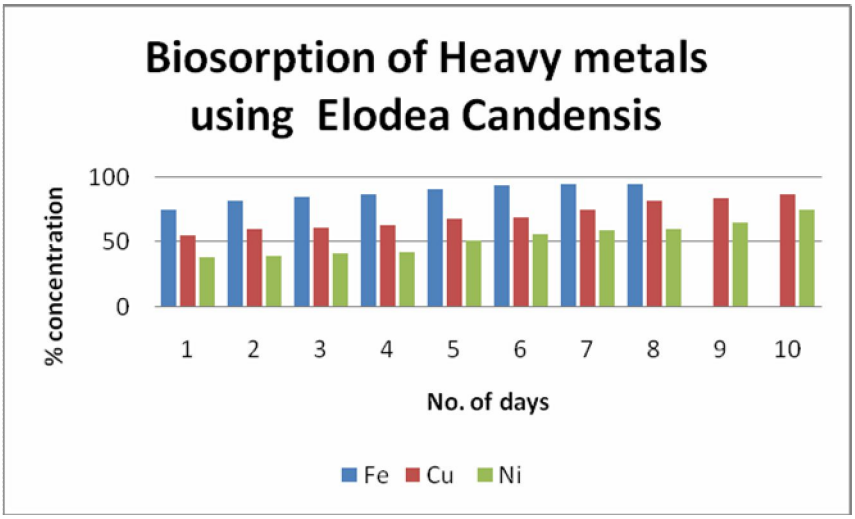
Table -2 Percentage of Bio sorption of Heavy metals by aquatic plants

No. Of days	Hydrilla vercillata Casp.,			Elodea canadensis Rich			Salvinia. sp.,		
	% Biosorption of heavy metals								
Heavy metals	Fe	Cu	Ni	Fe	Cu	Ni	Fe	Cu	Ni
1	80.2	60.6	53	75	55	38	53	33.6	20.6
2	83	62	49	81	60.2	39	73	34	21
3	84.8	62.4	59	84	60.4	41	77.6	34.8	21
4	87	68.8	60.2	86.2	63	42.2	75.6	31	24.2
5	91.2	70.6	63	90.6	67.2	51	71	44.4	28.6
6	-	69	64.8	93	68.8	55.4	79.2	49	32.6
7	-	76	68.8	94	75	59	80.8	49	35.2
8	-	81	71.2	94.4	81	60	83	51.6	31.6
9	-	82.8	80.2	-	83.4	64.8	85	62.6	35.4
10	-	89.2	83	-	86.4	75	88.8	67	40.4

Figures- Biosorption of Iron, copper and Nickle







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