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RESEARCH ARTICLE

PHYTOREMEDIATION OF WATERBODIES USING SELECTED AQUATIC MACROPHYTES- *EICCHORNIA CRASSIPES* (MART.) SOLMS AND *PISTIA STRATIOTES*, L.

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ABSTRACT

The present work was aimed to study the phytoremediation of water bodies using *Eicchornia crassipes* (Mart.) Solms and *Pistia stratiotes*, L. The water was analysed before and after the introduction of the plants. The amount of sulphate, nitrite, chloride and carbon dioxide was found to be lesser in the water treated with *Eicchornia crassipes and Pistia stratiotes* compared to untreated water.

INTRODUCTION

Water is one of the most important precious of natural resources and regular and plentiful supply of clean water is essential for the survival and health of most living organisms. Water is polluted mainly due to the release of solid city refuse and solid or liquid waste of industry (Dev Rao, 1979). Most of the rivers and fresh water stream in India are badly polluted by industrial waste or effluents which come along waste water of different industries. Lack of waste water treatment facilities or their inefficiency is the single greatest cause of gross pollution of water. Phytoremediation is the direct use of living green plants for in situ, or in place, removal, degradation or containment of contaminants in soils, sludge, sediments, surface water and ground water. Phytoremediation is a low cost, solar energy driven clean up technique. It is useful for treating a wide variety of environmental contaminants. Effective with or in some cases, in place of mechanical cleanup methods. . Extensive studies on freshwater resources decontamination revealed that some fresh water plants, among which is the water hyacinth growing prolific in waste water can efficiently. Many aquatic plants have been used to remove nutrients from eutrophic waters but, *Pistia statiotes* proved superior to most other plants in nutrient removal efficiency, owing to its rapid growth and high biomass yield potential.

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MATERIALS AND METHODS

The plants selected for the present study was *Eichhornia crassipes* (Mart.) Solms and *Pistia stratiotes*, L. *Eichhornia crassipes* (Mart.) Solms belongs to the family Pontederiaceae is a prolific free floating aquatic weed found in tropical and subtropical areas of the world. Leaves are green in colour, rosette, paddle shaped and apex rounded. *Pistia stratiotes*, L. belongs to the family Araceae is a floating, stoloniferous herb found in ponds and herbs almost throughout India. Leaves are light green in colour, odorless and bitter in taste. The leaves are approximately 13cm long and 17cm wide and of fan shaped having parallel venation, blunt apex, and entire margin covered by short hairs.

Parameters selected for the study were as follows,

Collection and maintenance of sample. Two glass tanks of similar size were selected and 8 liters of polluted water was taken. *E.crassipes* and *P.stratiotes* was collected and introduced in to these tanks separately. The tanks were transferred to a place where uniform environmental conditions were available. Plants are allowed to grow for 20 days. Then the following parameters are noted.

3. Analysis of water

It includes the analysis of oxygen, carbon dioxide, chlorine, sulphate and nitrite. The water was analysed before and after the introduction of plants.

3.1 Determination of dissolved oxygen content of water sample

3.1.2. Procedure (Azide modification of Winkler methods)
Water sample was collected in a 300ml BOD bottle without introducing air bubbles. BOD bottle was rinsed with water sample. Then allowed to overflow twice or thrice the volume. 1ml of $MnSO_4$ was added and mixed well. Add 1ml of alkali iodide azide reagent. Pipette with their tip below the water surface. BOD bottle was stoppered and mixed well and kept for sometimes for settle down the precipitate. After the settling of precipitate 1ml of concentrated H_2So_4 was added, restopperred and mixed well by inserting several times until the dissolution was complete. 100ml of this solution was taken in a 250ml conical flask and titrated against 0.01N $Na_2S_2O_3$ solution using starch as indicator. End point is the disappearance of blue colour. Volume of $Na_2S_2O_3$ added is noted. Titration is repeated to get a concordant value. Calculation is done by

$V_1N_1= V_2N_2$
V_1=Volume of sodium thiosulphate
N_1= Normality of sodium thiosulphate
V_2=Volume of water sample
N_2=Normality of water sample

3.2. Estimation of CO_2 in the water sample

CO_2 is an acidic oxide. It can act as acidic components in water medium. Known volume of water containing CO_2 is titrated against NaOH solution taken in the burette. Weight of CO_2 contained in the water sample can be calculated from the volume of NaOH used.

3.2.1. Reagents

a) Phenolphthalein indicator
b) 0.01N standard NaOH solution: 40g of NaOH was dissolved in distilled water and made up to 100ml. 10ml is pipetted out and made up to 100ml.

3.2.2. Procedure

50ml of water sample was taken in a clean conical flask. Few drops of phenolphthalein indicator were added. The water sample was titrated against NaOH solution taken in the burette. Appearance of light pink colour was noted as end point. The titration was repeated till the concordant values are obtained. It can be calculated by the formula, V1N1=V2N2.

V_1=Volume of NaOH
N_l=Normality of NaOH
V_2=Volume of water sample
N_2=Normality of water sample

3.3 Estimation of chlorine in water

In natural water its concentration remains quite low. Most important source of chloride in natural water is the discharged sewage. In very high concentration it gives a salty taste to the water.

3.3.1) Reagents

a) $AgNO_3$ (0.02): Dissolve 3.4g of prepared $AgNO_3$ in distilled water to prepare 1N solution, keep in a dark glassed bottle.
b) K_2CrO_4 5%: Dissolve 5g of K_2CrO_4 in 100ml of distilled water.

3.3.2) Procedure

50ml of water sample was taken in a conical flask. 2ml of K_2CrO_4 was added. It was titrated against 0.02N $AgNO_3$ until a persistent reddish brown tinge appears, titration was repeated v till concordant values are obtained. Calculation is done by,

$V_1N_1=V_2N_2$
V_1=Volume of $AgNO_3$
N_1=Normality of $AgNO_3$
V_2=Volume of water sample
N_2=Normality of water sample

3.4) Estimation of Nitrite in the water sample

Nitrite forms a diazonium salt with sulphanilic acid medium (2.0-2.5 pH) which combines with α-Naohthylamide hydrochloride to form a pinkish dye. The colour so produced obeys Beer's law and can be determined calorimetrically.

3.4.1) Reagents

a) Sulphanilamide solution

Dissolve 5g of Sulphanilamide in a mixture of 50ml concentrated HCl and about 300ml distilled water. Dilute to 500ml with water.

b) N(1-naphthyl)-Ethylendiamine dihydrochloride solution. Dissolve 0.50g of dihydrochloride in 500ml distilled water.

3.4.2) Procedure

To 50ml of the water sample, add 1ml sulphanilamide solution. Allow the reagent to react for 2-8 minutes. Then add 1ml N (1-naphthyl)-Ethylene diamine dihydrochloride solution and mix immediately and note the absorbance at 543 nm.

OBSERVATIONS AND RESULTS

3) Water Analysis

Detection of dissolved CO_2, Chloride, Nitrite and Sulphate

The water sample is analysed before and after the introduction of the source plants. The water analysis shows that the amount of CO2, chloride, nitrite, sulphate and dissolved oxygen are more in untreated water and are less in the water treated with *Eicchornia crassipes* and *Pistia stratiotes.* The amount of CO2 in untreated water is 1.76 mg/ml whereas amount of CO2 in water sample treated with Eicchornia and Pistia is 0.88 mg/ml. The amount of chloride is 43.6 mg/l in untreated water and it is reduced to 29.1 mg/ml in the water sample treated with *E.crassipes* and is 29.4 mg/ml in water treated with *P.stratiotes.* The amount of sulphate present in untreated water sample is 3 µmol/l, whereas it is 0.5µmol/l in both the water sample treated with *E.crassipes* and *P.stratiotes.* The amount of nitrite in untreated water is 3 µmol/l while the amount of sulphate in water sample treated with E.crassipes and P.stratiotes are 0.5 µmol/l and 1 µmol/l respectively. The

amount of dissolved oxygen in untreated water sample is 8.32 mg/l whereas the amount of dissolved oxygen in water sample treated with E.crassipes is 6.4 mg/l and is 7.68 mg/l in water sample treated with P.sratiotes.

Table 1. Water Analysis

Chemicals	Concentration of Chemicals in untreated Water sample	Concentration of Chemicals in water treated with *Eicchornia crassipes*	Concentration of Chemicals in water treated with *Pistia stratiotes*
Sulphate	3 µmol/l	0.5 µmol/l	0.5 µmol/l
Nitrite	2 µmol/l	1 µmol/l	0.5 µmol/l
Chloride	43.6 mg/ml	29.4 mg/ml	29.1 mg/ml

DISCUSSION

Developing cost effective and environment friendly technologies for the remediation of water polluted with toxic substances is a topic of global interest. The bioaccumulation capacity of plants is useful in removing toxic heavy metals and trace elements from contaminated soil and water in a process called phytoremediation. Phytoremediation is an integrated multidisciplinary approach to the cleanup of contaminated water which combines the discipline of plant physiology. The contaminants are subjected to the degradation by enzyme present within the plants themselves. The phytoremediation provides an up to date source of technical information relating to current and potential pollution control waste minimization practices using this new old technology. This is fast developing and inexpensive process which can easily used by developing countries like India. The plant used in the phytoremediation technique must have a considerable capacity of metal absorption, its accumulation and strength to decrease the treatment time. The aquatic vascular plants possess a tremendous capacity of absorbing heavy metals from water and hence bring the pollution load down (Boyd, 1969). Qian et al. (1999) have reported the capacity of wetland plants to accumulate trace elements.

The present study was aimed to study the phytoaccumulation of various chemicals by the plants, *Eicchornia crassipes* (Mart.) Solms, and *Pistia stratiotes* treated with polluted water and are compared with control. Water analysis is done to evaluate the level of pollution and bioaccumulation of the plant. The plants will oxidise the metal in their tissue and bioconcentrate it. Zimmels et al., (2006) reported that *Pistia stratiotes*, and *Eichhornia crassipes* can purify the sewage waste and water purified by this method can be utilized to irrigate tree crops. Muthunarayanan etal. (2011) studied the phytoremediation potential of *E.crassipes* (Mart)Solms. The experiments have proved the efficiency of *Eichhornia crassipes* to remove the color and degrade the dye. Rai (2008) reported that the wetland plants have the ability to remove toxic metals from the polluted waste water by bioaccumulation. The result of the present study shows that the levels of nitrite, sulphate, chloride and CO_2 is reduced in the water treated with the plants. The results of this study indicate that the plants *Eichhornia crassipes* and *Pistia stratiotes* have great potential in removing various types of pollutants from the water bodies. The development of eco-friendly and efficient technologies for treating wastewater is one of the attractive research area. Phytoremediation is considered to be a possible method for the removal of pollutants present in wastewater and recognized as a better green remediation technology.

Summary and Conclusion

The present work was aimed to study the phytoremediation of water bodies by *Eicchornia crassipes* (Mart.) Solms and *Pistia stratiotes*, L. Following conclusions were drawn from the present study on the basis of the analysis conducted. The water was analysed before and after the introduction of the plants. The amount of sulphate, nitrite, chloride, carbon dioxide and dissolved oxygen was less in the water treated with plants *Eicchornia crassipes and Pistia stratiotes* and it was more in untreated water. From the results obtained, it can be concluded that the plants *Eicchornia crassipes* and *Pistia stratiotes*, L. are good accumulators of pollutants and could be used to treat waste water contaminated with various types of pollutants. Phytoremediation has been perceived to be a more environmentally- friendly "green" and low-technical alternative to more active and intrusive remedial methods and we can utilize the plants *Eicchornia crassipes* and *Pistia stratiotes*, for this. This process will continue to evolve and be applied as an effective mechanism for remediating, preserving and sustaining the water that are such an integral part of our natural world.

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