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Research Article

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Cadmium uptake by *Chlorococcum humicolum* and *Phormidium foveolarum*

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ABSTRACT

The presence of heavy metals in water and wastewater is increasing due to the industrial development-disposal in the sewerage or in the water bodies. Cadmium, mercury and lead are the big three heavy metals posing the greatest hazard to human health, in addition to As, Be and Cr which are known to be carcinogenic. Laboratory investigation was conducted to study the extent and efficiency of cadmium accumulation in Chlorococcum humicolum and Phormidium foveolarum. The accumulation of cadmium increase with increasing concentration of metals in the medium. The mutants tolerant to high level of cadmium metals were obtained by repeated sub culturing. Tolerance of Chlorococcum humicolum to cadmium 2mgl^{-1}to 12mgl^{-1} and Phormidium foveolarum 2 to 10 mgl^{-1}. Morphological changes were recorded in both Chlorococcum humicolum and P. foveolarum at higher level of cadmium

Key words: Cadmium accumulation in *Chlorococcum humicolum* and *Phormidium foveolarum*

INTRODUCTION

The heavy metal cadmium is a common environmental contaminant, particularly near industrial effluent discharge, mines, or in areas where oil is burned for heating purposes. It is most commonly found metal and associated with zinc in carbonate and sulfide ores. In nature, cadmium and its similarity with zinc, is always associated with zinc ores (Zns). In the smelting process, due to its volatility, it causes pollution of air and soil around smelters in addition to possible inputs into aquatic environment through liquid effluent discharges. Uptake of heavy metal has important implications in wastewater. The uptake of heavy metals towards eukaryotic algae has been widely investigated and reviewed by (1, 2, 3, 12, 14, 15, 17, 20).Bio-absorption has important implication in waste water treatment. Microorganism could be used to remove heavy metal from waste water , the ability of algae however to concentrate cadmium may provide a means by which this metal could be safely removal from waste water (15) .

The present study undertaken to demonstrate the effects of varied sub lethal cadmium concentration on total extent and efficiency of bioaccumulation by *Chlorococcum humicolum* and *Phormidium foveolarum.*

EXPERIMENTAL SECTION

Preparation of stock solution of heavy metal:- The stock solution of metal was prepared by adding 4.3979gm $ZnsO_4$.$7H_2O$, 3.9282gm $CuSO_4.5H_2O$and $3CdSO_4.8H_2O$ to 100ml distilled water separately. These stock solutions contain 1ml=10mg Zn, Cd, Cu. The metal solution was stored in polyurethane bottles and was prepared after every month. The metal solution was diluted to various concentrations in the range of 0.01-10mgl^{-1} to determining inhibitory level. The solution was autoclaved separately.

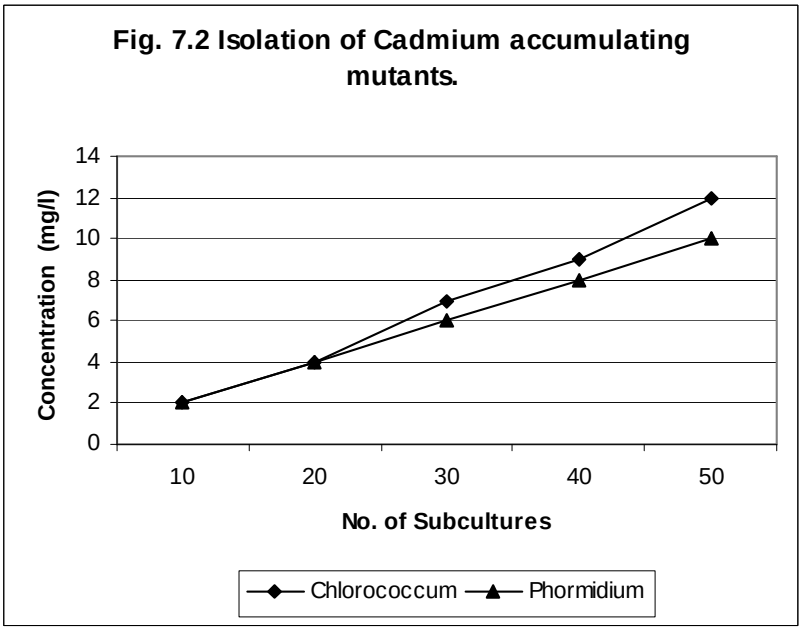
Determination OF Inhibitory Level and Section of Test Algae.

The selection of heavy metals done on the basis of their occurrence in sewage treatment plant. It has been frequently observed that industrial wastewater is contaminated with Cd as metal are often used in electroplating industrial operation. An inhibitory level of each alga to Cd was determined by selecting the range of 0.01- to 10mg. The experiments on cadmium toxicity were carried out considering BG-11, as basal medium. Algae in culture flasks were maintained that for 20 day at 26-30 ^{0}C with photon flux density 20-30 µmol photon m-^{2}s-^{1}. Strongly inhibitory level of each alga was determined for cadmium.

Production of resistant strains

The resistant strains obtained by training, with these metals does not lose their resistance by sub-culturing without metal or during long term sub-culturing for 20-30 generations at low concentrations of metal. When culturing in the presence of metal is repeated, the resistance of the culture becomes more stable.

Sr.no.	Metal	Strain	Absorbed metal	Adsorbed metal	Total accumulation
Chlorococcum humicolum	Cadmium	Cd - 12	6	2.5	8.5
Phormidium foveolarum	Cadmium	Cd - 10	6.7	2.1	8.8
Age of alga 20 days old.					
Metal concentration is in mgl^{-1}.					



RESULTS AND DISCUSSION

Chlorococcum humicolum and Phormidium foveolarum was collected from industrial site and brought in the laboratory. In laboratory resistance of *Chlorococcum humicolum* and *P. foveolarum* to Cadmium increased by repeated sub culturing a inhibitory levels of cadmium to the algae .The process was repeated 50 times, leading to gradual increasing strong inhibitory level. The tolerance cadmium 2 to 12 mg^{-1} for *Chlorococcum humicolum* and *P. foveolarum* 2 to 10 mgl^{-1} . The resistant strains obtained by training, with these metals does not loose their resistance by sub culturing without metal or during long term sub culturing for 20-30 generations at low concentrations of metal. When culturing in the presence of metal is repeated, the resistance of the culture becomes more stable. *Chlorococcum humioclum*, has accumulated 6.4 mgl^{-1} copper per dry weight of alga it includes 5.6mgl^{-1} absorbed copper and 0.8mgl^{-1} adsorbed copper per dry matter of alga. Cyano- bacterium *P. foveolarum* has accumulated 8.8mgl^{-1} cadmium per gm dry matter of alga where in 6.7mgl^{-1} as absorbed cadmium and 2.1mgl^{-1} as adsorbed cadmium per dry weight of *Phormidium.* The levels of cadmium in natural water range from < 1.0ppb to >10ppb (2, 21) reported 2.0mgl^{-1} cadmium tolerant strains of *Anaysistis nidulans.* In this investigation, increased tolerance of *Chlorococcum humioclum* to 2.0mgl^{-1} to 12 mgl^{-1} and *P. foveolarum* 2 to 10 mgl^{-1} in 40 to 50 subculture to attend

this tolerance. In present investigation, morphological changes were recorded in both *Chlorococcum humicolum* and *P. foveolarum* at higher level of cadmium. In a strain of *Chlorococcum humicolum* there was no external morphological changes but it produces many autospores in the cells which may be due to higher concentration of each metal in the growth media, *P. foveolarum* exhibit scanty contents as the cells may try to adapt in an adverse condition for its growth and survival were in agreement with the results reported by (4 ,16) concerning the tolerance and resistance of green algal species to heavy metal ions (as Cu, Cd, Pb and Zn) . Four algal sp. *Monochrysis lutheri* , *Isochrysis galbana Dunaliella euchlora* and *Phaeodactylum triconutum* their adaptation to grow in an inhibitory concentrations of Cu, Cd, and Zn in laboratory cultures (20) . All the species showed some capability to adapt to one or more metals in several subcultures. Increase the resistance of *Anacystis* to the five metals tested (Co, Zn, Ni, Cu, and Cd) (2.45mgl^{-1}, 5.5mgl^{-1}, 1.30mgl^{-1}, 0.55mgl^{-1} and 2.5mgl^{-1}reported by (21) by repeated sub culturing at inhibitory levels of the metals. Also the results in the present study were in accordance with those of who reported(18)that Cyano bacteria were found to be sensitive to Cu, Cd, Pb and Zn whether or not isolated from polluted sites. While green algal species tended to have high tolerance even in isolates from unpolluted sites. Green algae *Chlorella vulgaris*, study indicated that which could cultivate at low cost, can be possible to use as an efficient bio-sorbent material for removal of Pb from wastewater (19).

CONCLUSION

The study indicated that the bio-accumulation by *Chlorococcum humicolum* and *Phormidium foveolarum* could be used as an efficient bio-sorbent material for the removal of cadmium ions from wastewater. The adsorption capacity for cadmium ions onto both algal sp. *Chlorococcum humicolum* and *Phormidium foveolarum* was found to be relatively high when compared with those of many other adsorbent materials have been reported for removal of heavy metals.

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