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**Research Article**

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# Adaptation of *Chlorococcum humicolum* and *Phormidium foveolarum* to copper

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**ABSTRACT**

*In recent years, the bio-sorption processes have been studied extensively using microbial biomass as biosorbent for heavy metal ions removal. In order to further study their biosorption potential, two algae Chlorococcum humicolum and Phormidium foveolarum have been studied under different initial metal concentrations. An experiment was conducted to study the rate of Cu accumulation in Chlorococcum humicolum and Phormidium foveolarum under laboratory condition. Algae isolated from sewage water treatment plant able to grow in copper concentration ranges from 0.1mgl$^{-1}$ to 10mgl$^{-1}$. Metal tolerant strain was obtained by repeated sub culturing. Tolerance of Chlorococcum humicolum to copper 1.5mgl$^{-1}$ to 7 and Phormidium foveolarum 1.8 to 10mgl$^{-1}$*

**Key words:** *Chlorococcum humicolum*, *Phormidium foveolarum*, Copper , metal strain

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## INTRODUCTION

Heavy metals are among the major concerns in wastewater treatment. Heavy metals are often derived from heavy industry, such as electroplating and battery factories. The treatment of this type of wastewater involves high cost techniques such as ion exchange, evaporation, precipitation, membrane separation etc. However, these common techniques are too expensive to treat low levels of heavy metal in waste water.Therefore a low cost biosorption process using algae as an adsorbent has lately been introduced as an alternative. The capacity of algae to accumulate metals from water and sediments has been demonstrated many times for field collection, usually from metal contaminated sites ( 2, 4 , 8 , 10 , 15 ) and for laboratory grown cultures (16) Cu ,Zn, Co, are the most important metals often found in effluent discharge from industries involved in manufacturing of alloys and in galvanization. Many investigations have been carried out for biosorption of heavy metals by the other important divisions of algae green and red algae (5). The effects of several factors such as *pH*, initial metal concentration and contact time were analyzed. Green algae *Cladophora fascicularis* was to be an effective and economical biosorbent material for the removal of heavy metal ions (3) Copper is essential micronutrient for algae (12). The capacities of four algal species i.e *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 (17). All the species showed some capability to adapt to one or more metals in several subcultures. This paper deals with isolation of *Chlorococcum humicolum* and *Phormidium foveolarum* to high level of Copper from industrial sewage treatment plant

## EXPERIMENTAL SECTION

### Selection of heavy metal and measurements of toxicity

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 Cu as metal are often used in electroplating industrial

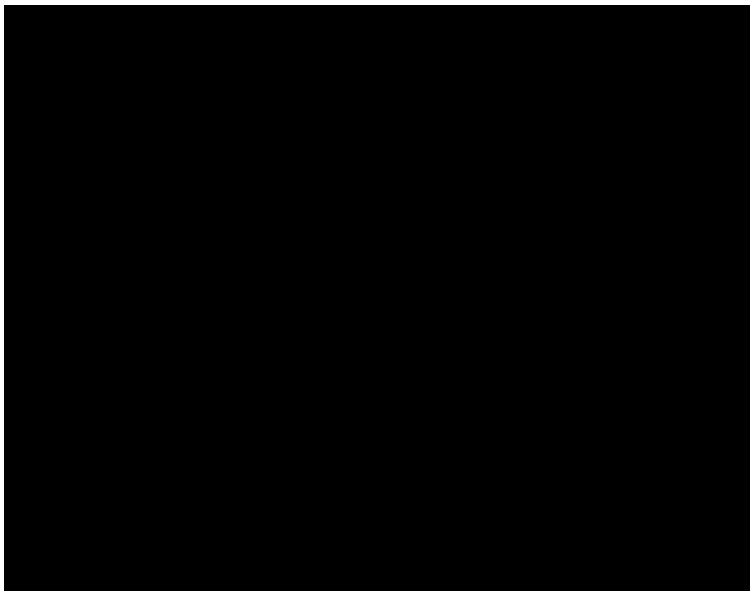
operation. An inhibitory level of each alga to Cu was determined by selecting the range of 0.01- to 10mg. The experiments on copper toxicity were carried out considering BG-11, as basal medium. Algae in culture flasks were maintained that for 20 day at 26-30 $^0$C with photon flux density 20-30 µmol photon m-$^2$s-$^1$. Strongly inhibitory level of each alga was determined for copper.

**Production of resistant strains**

*Chlorococcum humicolum* and *Phormidium foveolarum* were collected from industrial site and brought in the laboratory. In laboratory, their tolerance to Cu were increased. The tolerance of *Chloroccocum* to copper from ranged from 1.5 to 7 mg$^{-1}$ and for *Phormidium* 1.8 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**.**

**Table 1 Accumulation of heavy metals**

| Sr.no. | Metal | Strain | Absorbed metal | Adsorbed metal | Total accumulation |
|---|---|---|---|---|---|
| *C.humioclum* | Copper | Cu - 7 | 5.60 | 0.80 | 6.40 |
| *P. foveolarum* | Copper | Cu - 10 | 6.80 | 2.0 | 8.80 |
| *Age of alga 20 days old.* | | | | | |
| *Metal concentration is in mgl$^{-1}$.* | | | | | |



**RESULTS AND DISCUSSION**

Copper concentration added to the culture medium in concentration from 0.1 to 10 mgl$^{-1}$. In laboratory resistance of *Chlorococcum humicolum* and *Phormidium foveolarum* by repeated sub culturing. The tolerance of *Chlorococcum humicolum* to copper from 1.5mgl$^{-1}$ to 7mgl$^{-1}$ and *Phormidium foveolarum* 1.8 to 10mgl$^{-1}$. 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. Total accumulated metals were calculated by adding adsorbed and absorbed amount of heavy metals *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. Similarly *P. foveolarum* has accumulated 8.8mgl$^{-1}$ per gm dry matter of alga including 6.8mgl$^{-1}$ absorbed copper and 2.0mgl$^{-1}$ adsorbed copper per dry weight of alga (Table 1) . In our study *Chlorococcum humicolum* and *Phormidium foveolarum* tolerated Cu levels mush higher from those given by (10 ,18 ). In present investigation Cu tolerated stains obtain by repeated 50 sub culturing. *Chlorococcum humicolum* to copper 1.5mgl$^{-1}$ to 7mgl$^{-1}$ and *Phormidium foveolarum* 1.8 to 10mgl$^{-1}$ (Fig 1) . In present investigation, morphological changes were recorded in both *Chlorococcum humicolum* and *P. foveolarum* at higher level of copper. In a strain of *P. foveolarum*,

constriction at the septa in the trichome or it gives beaded appearance in 10 $mgl^{-1}$ of copper, whereas in *Chlorococcum humicolum* there were no external morphological changes but it produces many auto spores in the cells, which may be due to higher concentration of each metal in the growth media. Adaptation of copper by algae reported by several worker, copper uptake by *Cyclotella meneghiniana* and *Chlamydomonas reinhardi*ti (1).Uptake and accumulation of copper (0.1 to 0.5ppm) metal tolerant stains of *Scenedesmus* by (13). Increase the resistance of *Anacystis* to the five metals tested (Co, Zn, Ni, Cu, and Cd) (2.45$mgl^{-1}$, 5.5$mgl^{-1}$, 1.30$mgl^{-1}$, 0.55$mgl^{-1}$ and 2.5$mgl^{-1}$ reported by (18) . Sub culturing at inhibitory levels of the metals (7) reported nine hevy metal (Pb, Cd, Cu, Co, Cr, Ni, Zn ,Fe & Mn , uptake by periphyton algae *Cladophora glomerata* and *Oedogonium rivulare* .Adaptation of *Selanastrum capicornutum* to copper (0.8M to $10^{-12}$M ) reported by ( 6, 7 ) . Toxicity and uptake of iron, zinc and copper by *Oscillatoria perornata* var. *alfonata* and *Scenedesmus quadricauda* var. *longis pina*, concentration up to 20.67, 0.595, and 0.0188$mgl^{-1}$ for *Scenedesmus* and 27.56, 0.833 and 0.0207$mgl^{-1}$ for *Oscillatoria* reported by (11).

## CONCLUSION

Both the algal strains of *Chlorococcum humicolum* and *Phormidium foveolarum* proves efficient towards adaption of Cu, ions . Algae are a cheap and effective adsorbents for the removals of Cu ion from wastewater. This experimental study on adsorbent would be quite useful in developing appropriate technologies for the removals of heavy metals ions from industrial domestic effluent.

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