

Heavy metal accumulation in *Oscillatoria* sp. induced biochemical response

¹Nayana Brahmhatt, ¹Rinku Patel and ³R. T. Jasrai

¹V. P. Science College, Botany Department, Sardar Patel University, Vallabh Vidyanagar, Gujarat, India

²R. K. Parikh Arts and Science College, Petlad, Gujarat, India

ABSTRACT

Industrial wastes has been recognized as one of the major source of heavy metal pollution in environment resulting into serious consequences. *Oscillatoria* sp. has shown promise in the biological management of pollutants because of its high potential to absorb heavy metals. Exponentially growing algae of *Oscillatoria* sp. were exposed to various concentrations (2, 5, 10, 20 & 30ppm) of Cr and Pb for 21 days. Algae accumulated appreciable amount of both metals from solution, however, accumulation of Cr was lower compared to Pb. At same doses also estimated various biochemical activities including chlorophylls (chl-a, chl-b & total chl), protein, proline and sugar in these experiment. Chlorophyll content in the algae increased at all doses of the metals in comparison to unstressed algae which could be used as biomarker of metal toxicity.

Keywords: Heavy metals, *Oscillatoria* sp., biochemical parameters, bioaccumulation

INTRODUCTION

Rapid industrialization and urbanization in the last century have led to the problems of environmental pollution and ecological damage. An indiscriminate and excessive uses of synthetic fertilizers and chemicals have damaged the ecosystems considerably. Heavy metal contamination of water and soil may create major environmental and human health problems. Among the heavy metals, lead particularly has become a cosmopolitan environmental pollutant (Sharma & Dubey, 2005). Bioremediation typically provides an efficient and economical way to reduce environmental toxins using indigenous or introduced microbes that naturally degrade contaminants. The major advantage of bioremediation is that it is a natural process and can be used at much lower cost than many other treatment technologies.

Various studies have been carried out to show the role of algae in the bioremediation of heavy metals. Heavy metals such as Cu, Pb, Cd, Co are removed by *Cladophora glomerata* and by *Oedogonium rivulare* as short term and others such as Ni, Cr, Fe, Mn as continuous uptake (Vymazal, 1984). The accumulation of cadmium was studied in an experimental aquatic phytoplankton *Chlorella vulgaris* as a primary producer (Ruangsoboon and Wongrat, 2006). Heavy metal biosorption capacities from aqueous solution at different initial concentration of the heavy metals Cd, Hg and Pb and at different contact period (time) of dry biomass used brown and green marine macroalgae (Nirmal Kumar et al., 2009). The specific objectives of this study are to determine metal concentrations factors and to quantify the relationship between metals concentrations in the algae and their surrounding water. Oghenemise et al. (2011) was studies on the bioaccumulation of zinc, iron, copper, cadmium and aluminium by *Chlorella vulgaris*, *Phacus curvicauda*, *Euglena acus* and *Oscillatoria bornettia* for four weeks in the laboratory. Biochemical responses of the aquatic moss *Fontinalis antipyretica* to Cd, Cu, Pb and Zn determined by chlorophyll fluorescence and protein levels (Raua, Miersch, Neumann, Weber and Krauss, 2007).

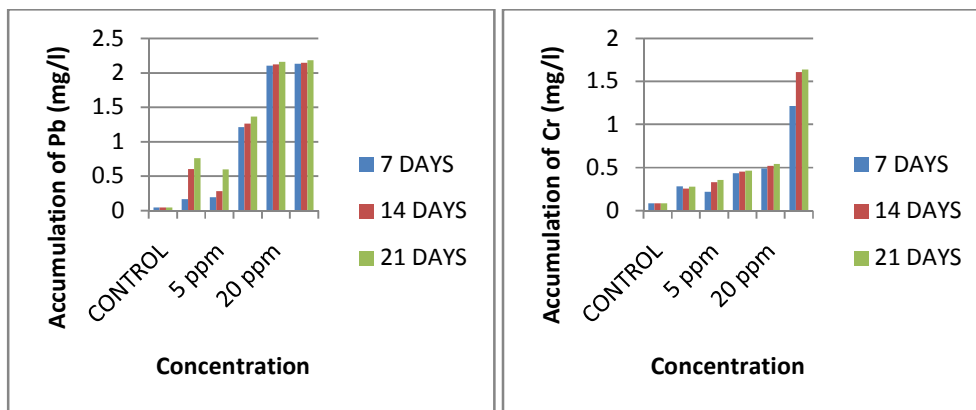
MATERIALS AND METHODS

The wastewater alga *Oscillatoria* sp. was collected from industrial wastewater at Ankleshwar GIDC area. Algae were thoroughly washed up by tap water to remove any epiphytic algae attached to it. *Oscillatoria* sp. isolation was carried out by identification of algal species by their characterization with the help of standard monographs (Desikachary, 1959) books and papers published in different scientific journals. The media preparation and the culturing methods were carried out following standard methods of (Allen- Arnon method, 1955) to culture of *Oscillatoria* sp. The selected algae sp. was treated with lead and chromium solutions of different concentrations and intervals of time work has been under process of accumulation. In these experiments, intermediate term toxicity test was designed as per standard method (APHA-AWWA-AWPC, 1989). In this test, culture the algae, set conditions for metal accumulation and estimation of biochemical parameters like Sugar, Protein, Proline and Chlorophylls (Chl-a, Chl-b, Total Chl) are carried out. The lead and chromium metals solutions of 2, 5, 10, 20, and 30 ppm concentration were used. Algal sample harvested after 7, 14 and 21 days of incubation, were washed repeatedly, dried and digested in HClO_4 , HNO_3 (1:4 V/V) for heavy metal analysis and diluted with double distilled water. The various concentrations of metals were measured by using Inductively Couple Plasma spectrometer, Perkin Elmer Corporation (ICP optima 3300RL). Sugar was determine following (GOD-POD test). Protein content was determined in accordance with the method of Lowry et al. (1951). Proline was estimated following (Thimmaiah, 1999). Chlorophylls (Chl-a, Chl-b and total chl) concentrations were determined following published procedures (Arnon, 1949).

RESULTS AND DISCUSSION

The results of the study are presented in Fig.1-5. In *Oscillatoria* sp., accumulation of lead and chromium after treatment decreasing trend after day by day. The highest accumulation showed at 2ppm of 7 days treatment and lowest at 30ppm at 21 days, in both experiments the alga decreased metal accumulation capacity after increasing the treatment period.

Fig-1: Accumulation of Pb and Cr in *Oscillatoria* sp. of different concentration at different period.



Protein proline and sugar content were decreased with increasing metal concentration. Sugar content was increased after treatment at 21 days of all concentration of Pb and Cr (fig-4). Chlorophyll content is one of the important biochemical parameters, which is used as the index of production capacity. In this study Chl-a, Chl-b and total chlorophyll were reduced under chromium and lead treatment at higher concentrations. Chl-b pigment was higher than chl-a in there observations.

Abirhire and Kadiri (2011) was reported *Oscillatoria* had the highest metal concentration factors for Zn (0.306), Fe (0.302), Cu (0.091) and Cd (0.276) whlie *Phacus curvicauda* and *Euglena acus* had the same and highest value for Al (0.439). Brahmhatt and Rinku (2011) investigated proline and protein content decreasing trend and sugar content increasing trend with the increasing trend of lead metal concentration after the treatment of day by day in *Pithophora*. Enany and Issa (2001) reported the accumulation of proline was correlated it with protein content.

Fig-2: Protein content in *Oscillatoria* sp. after accumulation of Pb and Cr in different concentration at different period.

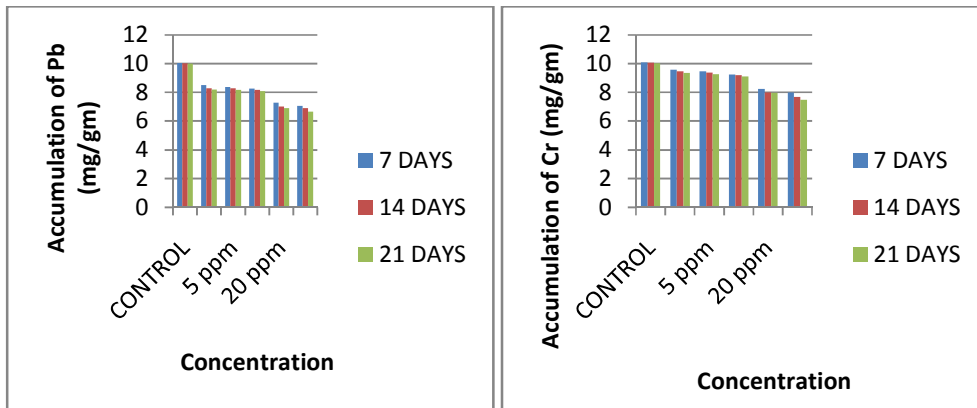


Fig-3: Proline content in *Oscillatoria* sp. after accumulation of Pb and Cr in different concentration at different period.

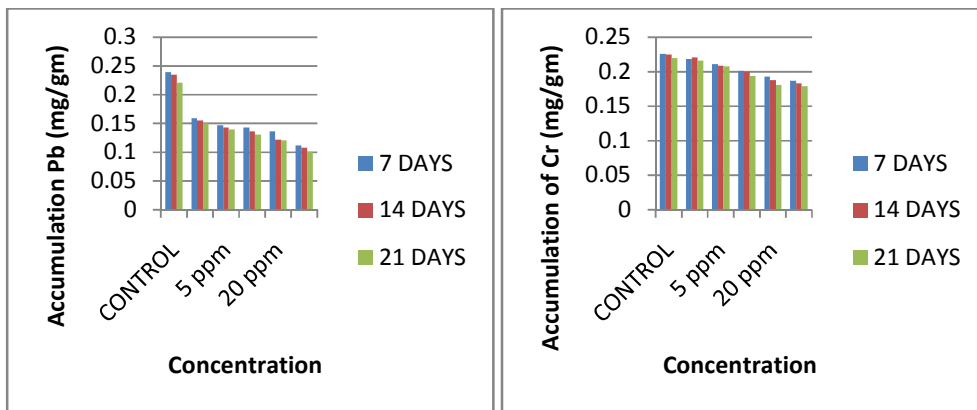


Fig-4: Sugar content in *Oscillatoria* sp. after accumulation of Pb and Cr in different concentration at different period.

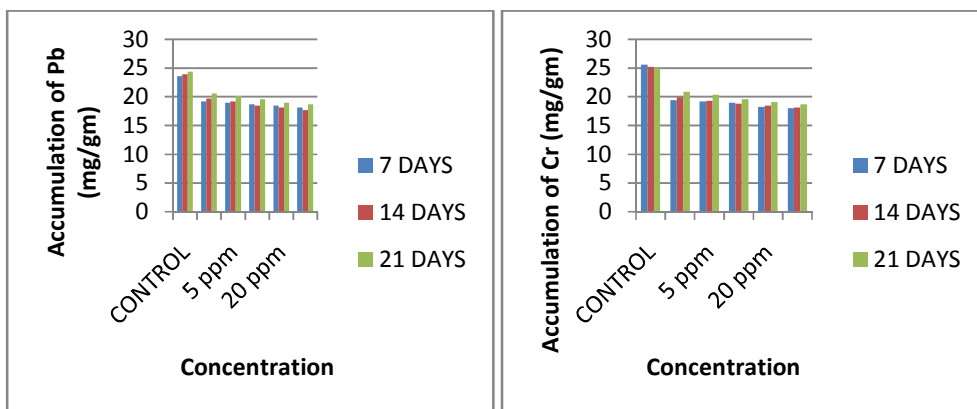
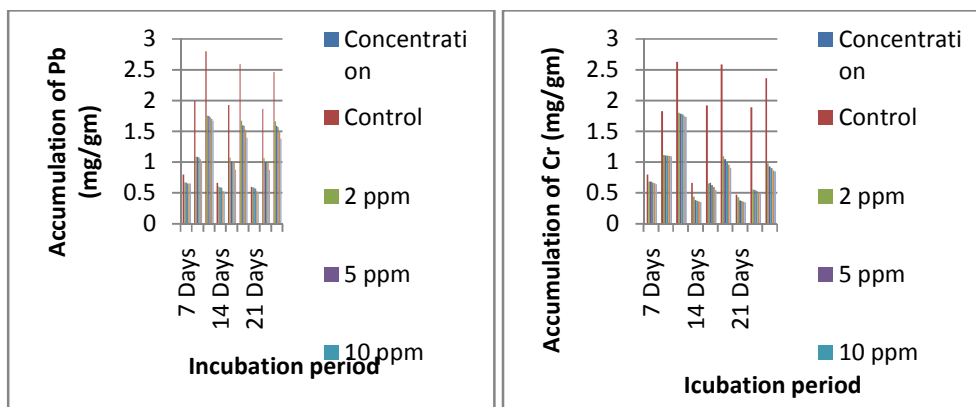


Fig-5: Chlorophylls content in *Oscillatoria* sp. after accumulation of Pb and Cr in different concentration at different period.

CONCLUSION

After this study, it has been concluded that accumulation of Pb and Cr on *Oscillatoria* sp. are in order of: Pb > Cr and this metal affect on biochemical parameters.

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