ISSN: 2249 - 7862
Aureole, Vol. VII, December 2015, PP 69-76

STUDY ON BIOSORPTION OF HEAVY METALS BY BLUE GREEN ALGAE

* Bijimol K.V
** Prathibha V.R

Abstract

The present work aimed to find out the metal absorption capability of blue green algae of marine *(Synechocystis salina)* and fresh water *(Mycrocystis sp.)* habitat. Selected metals were Cobalt, Copper and Zinc. The metal absorption was taken at varying concentration and pH . Results showed that both freshwater and Marine Blue green algae were equally good for the process of biosorption. The process of metal absorption was pH dependent and concentration dependent. Both Marine and freshwater Blue green algae were found to work best at pH 8. Another significant observation was that, the maximum absorption of metals takes place within 30 minutes. More than 90% of metal is absorbed within this time, by both the organisms. Selected Blue green algae can be used as an effective and eco-friendly tool in pollution control technology

Keywords **:** *Bluegreen Algae, Biosorption, heavy metals*

**Guest. Lecturer, Department of Zoology,St.Stephen's College,Uzhavoor,*
*** *Department of Biotechnology, Al-Azhar College of Arts and Science, Thodupuzha*
E mail : kvbijimol@gmail.com

Introduction

Biosorption is the removal of metals from the solution by biological material. Bacteria, Microalage etc can be used as efiicient biosorbents. Metals are elements that occur naturally in rocks in relatively low concentrations (Eteri, 2013). Since heavy metals exert toxic effects on living organisms, they are termed toxic heavy metals. A wide range of anthropogenic activities contribute to the discharge of heavy metals to the environment, for example, intensive agriculture, metallurgy, energy production, and microelec- tronic and sewage sludge (Drora Kaplan 2013).

The presence of heavy metals in the environment is a major concern because of their toxicity to flora and fauna (Adefila et al., 2010) Heavy metals are stable and persistent environmental contaminants since they cannot be degraded or destroyed. Therefore, their toxicity poses major environmental and health problems and requires a constant search for ef?cient, cost-effective technologies for detoxi?cation of metal-contaminated sites.

Even though several methods are used for removing heavy metal ions from aqueous wastes, each method has its own merits and demerits. Experiments using chemical precipitation and electrochemical treatments appear to be ineffective especially when the metal ion concentration in aqueous solution is lower than 50 mg/l while ion exchange membrane technologies and activated carbon adsorption processes are expensive (Das et al., 2008). This has resulted in increased research focusing on new cost effective technologies for removal of heavy metals from waste waters. Yet, in recent years, with the increase in awareness and more stringent regulation, there is increasing interest in applying biological approaches for this purpose.

Of late, the attention has shifted to the use of biosorbants of biological origin especially to non-living dry algal biomass and other microorganisms for metal removal. Studies using biosorbants have shown that both living and dead microbial cells are able to uptake metal ions (Knorr, 1991; Khoo and Ting, 2001; Das et al., 2008). Microalgae especially Blue green algae plays a significant role in the transformation of heavy metal ions in the environment.Blue green algae are large diverse group of photosynthetic bacteria.The metal binding sites present on the cell wall of Blue green algae allows them to bind with heavy metals. So Blue green algae can be used as an effective measure to heavy metal toxicity. They absorb Heavy metals through a process known as Biosorption. The process of absorption and adsorption together known as Biosorption.

Biosorption is a new technology which involves removal of heavy metals from an aqueous solution by passive binding to non-living biomass (Davis et al., 2003). This technique has now gathered attention as it has several advantageous over other processes like reusability of biomaterial, low operating cost, short operation time and absence of secondary compounds (Spinti et al., 1995; Nirmalkumar and Oommen, 2012).

Methods

Isolation, Identification and culturing of blue green algae

Both fresh water and marine blue green algae were isolated, cultured and identified.

Freshwater Blue green alga was isolated from paddy soil in a suitable medium called Pringsheim's media and marine blue green algae was isolated in Walner's medium. Then the culture was incubated in alternative dark and light until it reaches the optimum growth. Proper agitation was needed during the incubation period. Identification of Blue green was done as per Desikachary (1959).

Preparation of Diluted concentrations of Metal solutions

5mg/5ml of the solutions of CuSO4,CoCl2 and ZnCl2 were prepared as stock solution and stored in a clean container. These solutions were serially diluted up to 10-5 times.

Setting up of Parameters

Two parameters used were pH and concentration. The metal concentrations used were 100mg/ml and 10 mg/ml. The absorption of metals at those concentrations was checked at pH5, 6,7and 8.

Checking of Metal absorption capability

Metal absorption capability of Blue green algae was determined using Spectrophotometer at 480nm by keeping 5ml cultures in metal solution .Incubated at room temperature for 30 minutes.The intensity of colour was measured colorimetrically at every intervals of 30 minutes.

Result and Discussion

Two blue green algae could be isolated and cultured. Out of these the organism which isolated from fresh water was identified as Microcystis sp. and that from sea water was identified as Synechocystis salina.

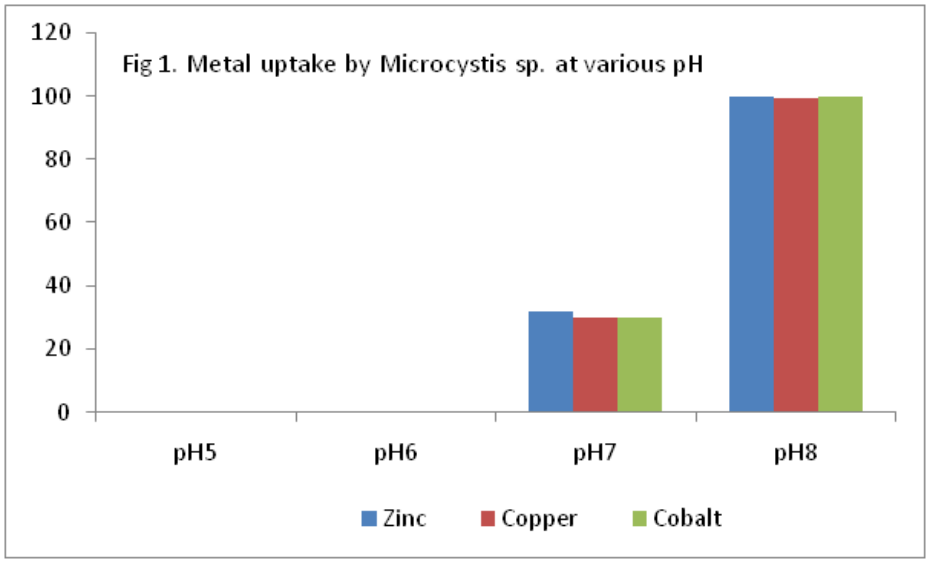
Uptake of metals by blue green algae at various pH and at different time interval are shown in Table 1 and 2

Table 1: Uptake of metals by at various pH

Metals	Metal uptake in mg/ml *Microcystis sp*				Metal uptake in mg/ml *Synechocystis salina*			
	pH 5	pH 6	pH 7	pH 8	pH 5	pH 6	pH 7	pH 8
Zinc	0	0	32	99.88	0	0	45	99.99
Copper	0	0	30	99.70	0	0	42	99.95
Cobalt	0	0	30	99.90	0	0	42	99.95

Table 2: Uptake of metals at various time interval

Conc.	Metals	Metal uptake in mg/ml *Microcystis sp*					Metal uptake in mg/ml *Synechocystis salina*				
		Time interval in minutes					Time interval in minutes				
		30	60	90	120	150	30	60	90	120	150
100mg /ml	Zinc	99.75	99.85	99.90	99.95	99.99	99.65	99.75	99.80	99.80	99.85
	Copper	99.00	99.50	99.77	99.70	99.75	98.00	98.50	98.70	99.00	99.00
	Cobalt	99.99	99.99	99.99	99.99	99.99	99.00	99.85	99.95	Nil	Nil
10mg/ ml	Zinc	9.30	9.98	9.99	Nil	Nil	9.40	9.94	9.99	Nil	Nil
	Copper	9.75	9.80	9.99	Nil	Nil	9.76	9.80	9.95	Nil	Nil
	Cobalt	9.75	9.80	9.99	Nil	Nil	9.75	9.80	9.90	Nil	Nil



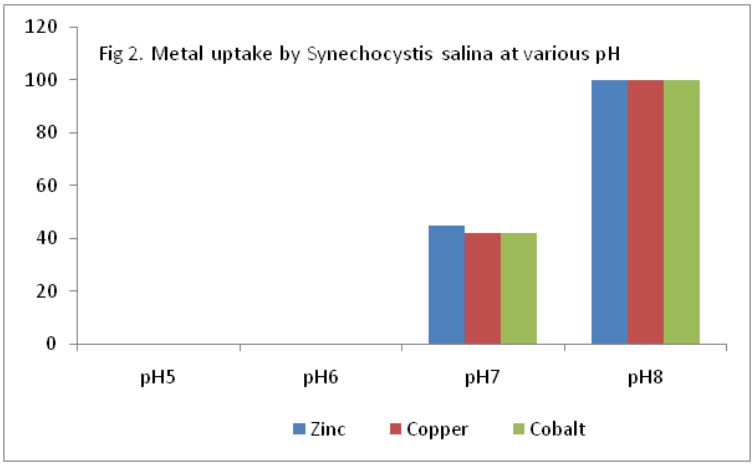


Fig 2. Metal uptake by Synechocystis salina at various pH
120
100
80
60
40
20
0
pH5
pH6
pH7
pH8
Zinc
Copper
Cobalt

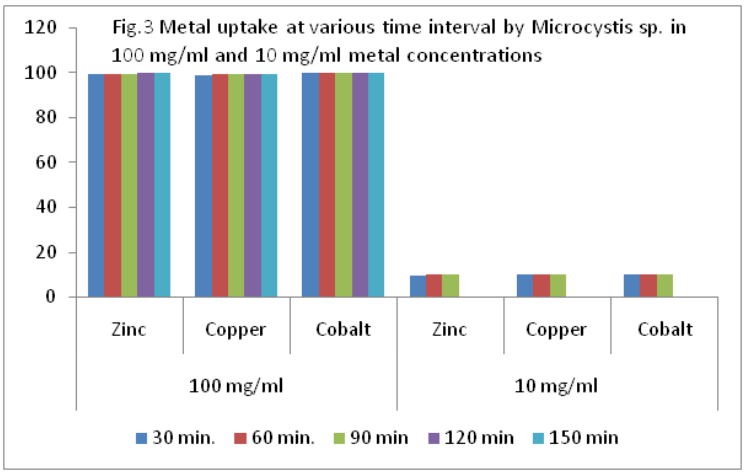


Fig.3 Metal uptake at various time interval by Microcystis sp. in 100 mg/ml and 10 mg/ml metal concentrations
120
100
80
60
40
20
0
Zinc
Copper
Cobalt
Zinc
Copper
Cobalt
100 mg/ml
10 mg/ml
30 min.
60 min.
90 min
120 min
150 min

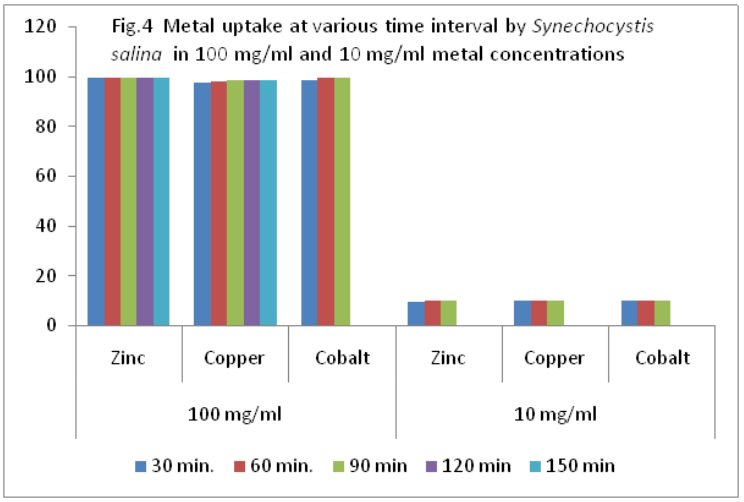


Fig.4 Metal uptake at various time interval by Synechocystis salina in 100 mg/ml and 10 mg/ml metal concentrations
120
100
80
60
40
20
0
Zinc
Copper
Cobalt
Zinc
Copper
Cobalt
100 mg/ml
10 mg/ml
30 min.
60 min.
90 min
120 min
150 min

Discussion

Results showed that both Microcystis and Synechocystis salina were able to absorb metals namely Zinc , Copper and Cobalt. Both the organism showed a similar pattern of metal absorption efficiency at various pH and time interval.

Significant finding of the study is, process of metal absorption is pH dependent. Four different pH parameters were set out, of which at pH 5 and pH 6, the organism was not responding to the metals. The inference is the organisms were unable to grow in these pHs. At pH 7 and pH 8 the organism had shown metal absorption. pH 8 is found to be more suitable than pH 7. This may be because the organisms attain more growth at pH 8.

Metal Concentration was another parameter studied. The experiment was set out at 10mg/ml and 100mg/ml concentration of three metals such as zinc, cobalt and copper. It was found that, higher the concentration of metal ions, higher the rate of metal absorbance. That is the number of metal ion available for absorbance also affects the metal binding rate. As the concentration becomes lower, the rate of absorbance also decreases.

Absorbance efficiency between metals was not significant. Another significant observation was that, the maximum absorption of metals takes place within 30 minutes, which is the first set out time period. More than 90% of metal is absorbed within this time, by both the organisms. All the three metals show the same pattern. This may be because the organism would have utilized all the metal binding sites for sequestering the metal ions.

Therefore from the study it was come to the following conclusion :

Both the blue green algae were equally good for the process of biosorption.

The process of Metal absorption by Blue green algae was pH dependent and concentration dependent.

Selected Blue green algae can be used as an effective and eco-friendly tool in pollution control technology

References

1. Adefila EO, CT Onwordi, IA Ogunwande,Archives of Applied Science Research, 2010 , 2 (1), 347-353.
2. Das, N., Vimala, R. and Karthika, P. (2008).Biosorption of heavy metals An overview. Indian Journal of Biotechnology, 7: 159-169.
3. Davis Thomas, A., Volesky, B. and Mucci, A. (2003). A review of the biochemistry of heavy metal biosorption by brown algae. Water Res., 37: 4311-4330.
4 Desikachary, T.V., 1959. Cyanophyta- Indian Council of Agricultural Research, New Delhi.

5. Drora Kaplan(2013),Absorption and adsorption of Heavy metal by Microalgae,Handbook of Microbial culture:Applied Phycology and Biotechnology,2nd Ed.606-611.
6. Eteri Gelagutashvili,Comparative study on Heavy Metals Biosorption by Different Types of Bacteria,Open Journal of Metal,2013,3,62-67.
7. Khoo, K. M. and Ting, Y. P. (2001).Biosorption of gold by immobilized fungal biomass. Biochem. Eng. J., 8: 51-59.
8. Knorr, D. (1991). Recovery and utilization of chitin and chitosan in food processing waste management. Food Technol., 45: 114-122.
9. Nirmal Kumar, J. I. and Oommen, G. (2012).Removal of heavy metals by biosorption using freshwater alga Spirogyra hyalina. J. Environ. Biol., 33: 27-31.
10 Spinti, M., Zhuang, H. and Trujillo, E. M. (1995).Evaluation of immobilized biomass beads for removing heavy metals from wastewaters. Water Environ. Res., 67: 943-652.