



Using of *Chroococcus* sp. to Treat Polluted Water with Cadmium & Nickel

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Abstract: *Chroococcus* sp. was exposed to different concentrations 0.3, 0.5, 1, 2, 3, 4, 5, 6 and 7 ppm, from cadmium and nickel. The results revealed that the ability of the alga to remove cadmium and nickel was increased with the increase of the metal concentration which the alga exposed to them and this case does not record before. This may relate to mechanisms of adsorption and removal which not understood perfectly till now according to many researches that concerned with this field of studies. It was noticed that the removal percentage of cadmium reaches to 77.66 & 76% in the two higher concentrations 6 & 7 ppm, which exposed to the alga till the last day (twelve days) from the experiment, but same percentage (77.66 & 76%) was recorded on the eighth day of the experiment to remove nickel and decrease to 12.5 & 28% on the last day of the experiment for the above two concentrations.

Keywords: Biosorption, Alga, Wastewater, Cadmium, Nickel.

1. Introduction

Biosorption can be defined as the ability of biological materials to accumulate heavy metals from wastewater through metabolically mediated or physico-chemical pathways of uptake (1). Algae, bacteria, fungi and yeast have proved to be potential metal biosorbents (2). The major advantages of biosorption over conventional treatment methods include (3): low cost, highly efficient, minimization of chemical and /or biological sludge, no additional nutrient requirement, regeneration of biosorbent and possibility of metal recovery. Biosorption is mainly used to treat wastewater where more than one type of metal ions would be present; the removal of one metal ion may be influenced by the presence of other metal ions.

The mechanism of biosorption means the complex structure of microorganisms implies that there are many ways for the metal to be taken up by the microbial cell. The biosorption mechanisms are various and are not fully understood. They may classify according to various criteria.

According to the dependence on the cell's metabolism, biosorption mechanisms can be divided into:

- a. Metabolism dependent and
- b. Non-metabolism dependent.

Basically, biosorption by living organisms comprises of two steps:

- a. First, a metabolism independent binding where the metals are bound to the cell wall and;
- b. Second metabolism dependent intracellular uptake, whereby metal ions are transported across the cell membrane (4).

According to the location where the metal removed from solution is found, biosorption can be classified as (5):

- a. Extracellular accumulation/precipitation;
- b. Cell surface sorption/precipitation and
- c. Intracellular accumulation

Classification of *Chroococcus* sp.:

Phylum: - Cyanophyta;
Class: - Cyanophyceae;
Order: - Chroococcales;
Genus: - *Chroococcus* sp. (6).

2. Materials and Methods

A Chu No. 10 medium which described by Chu, 1942 (7) and modified by Kassim, 1998 (8) was used to culture *Chroococcus* sp.

The medium prepared as stock solutions and keep in 4°C. 2.5ml was taken from each stock solution and add to 1 liter of deionized water to prepare the medium. pH was about 6.8-7. Sterilize by autoclaving with 121°C and 1.5 bar for 15 minutes. Keep at 4°C until use.

In order to get axenic culture, it was followed Patterson method (9) which is represented by:

“The algal culture will keep in the dark for 24 hours, then take about 10ml of this culture and transferred into sterilized and new medium and kept in the dark for 3 hours, then try to sediment the algal cell by centrifugation at 3000 cycles\ min. for 5 minutes (about 15 times) and wash the algal sediment with distilled water and later cultured the algal strain in a new medium in order to activate the isolated algal species”.

To ensure, there is no microbial contamination, streaking a swap of the culture on the nutrient agar medium incubated at 37°C for 48-72 hours.

The stock solutions of cadmium and nickel concentrations prepared with concentration 1000 ppm by dissolving aqueous cadmium chloride and nickel sulfate. It was added about 50ml of axenic culture to 1000ml of the medium containing lead ions, about 3 replicates were used for each concentration.

The alga was exposed to these concentrations and later would point the ability of algae to remove and tolerant lead by comparing the initial concentration of lead which is exposed to alga and the concentrations of

it in the filtrate, and then measure the concentration of lead infiltrate by using atomic absorption.

2.1 Statically analysis

SPSS program (Version 7.0) was used to analysis the data.

3. Results and Discussion

It was found that the higher removal percentage of cadmium by *Chroococcus* sp. be in the last days of the experimental period will be with low values in first days (Table 1), their results may relate to blocking the functional groups in the outer membrane of biosorbents in the first days as well as by the partial destruction of functional groups during the immobilization process (10).

The statically analysis indicates there is a significant difference between the concentrations from side; also there is a significant difference between the days of the experiments except the third and seventh days (Table 1).

Chroococcus sp. can remove nickel with percentage about 99% & 94% in the fourth & sixth days, respectively, for the concentrations 2 & 3 ppm.

As it is explained in Table (2), the removal percentage of nickel by the alga be with lower values in lower concentrations (0.3, 0.5 & 1 ppm), but it begins to be higher with the increase of the concentrations of the element. Usually, these results may relate to some reasons like an important role in the prediction of the selectivity metal uptake (10). Also, due to the variety of different binding mechanisms in the process of heavy metal uptake (ion exchange, microprecipitation and complexation), technical applications of biosorbents require investigations regarding the major kind of binding mechanism occurring in each specific case.

According to some studies (11, 12, 13), they found that the stage of development and variation in growth and chemical composition of the algae may influence the pattern accumulation.

The statically analysis explains there is a significant difference between the concentrations in each day of the experiment and among the days from other hand (Table 2).

Table 1. The effect of concentration & period in removal percentage of cadmium by *Chroococcus* sp.

Days	Cadmium Concentration (ppm)							LSD value		
	0.3	0.5	1	2	3	4	5		6	7
	Removal percentage (%)									
2	0	0	25	37.5	41.3	45.5	63.2	70.5	72.14	9.43*
4	0	10	37	40	40	48.75	61.2	71	72.14	9.68*
6	36.66	32	45	42	43	44.5	60.8	71.5	72.28	6.15*
8	40	42	41	37	43.6	50	65.6	73.66	75	6.02*
10	43.33	54	41	36	40.33	50	64	74.66	76	5.44*
12	43.33	54	40	36	40	50	68.8	77.66	76	5.57*
LSD value	7.83*	8.05*	5.23*	4.38*	4.66 ns	4.12*	5.91*	5.72*	6.22 ns	--

*(p<0.05)

Table 2. The effect of concentration & period in removal percentage of nickel by *Chroococcus* sp.

Days	Nickel Concentration (ppm)							LSD value		
	0.3	0.5	1	2	3	4	5		6	7
	Removal percentage (%)									
2	0	0	16	89.5	71.33	69	68.8	71.66	72.14	9.15*
4	0	4	41	99	94.33	76.5	64.8	71.66	72.28	9.26*
6	6.66	36	57	79.5	74.33	66.25	67.6	71.66	75.14	5.84*
8	16.66	40	9	82.5	68.33	63.5	69.2	77.66	76.00	7.55*
10	26.66	10	3	87	75	71.75	64.6	46.00	39.57	7.39*
12	33.33	10	3	79	78	71.50	64.6	12.5	28.00	6.69*
LSD value	6.37*	6.59*	6.07*	5.33*	5.72*	5.03*	5.88 ns	7.42*	6.20*	--

*(p<0.05)

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