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THE EFFECT OF COBALT AND NICKEL ON THE GROWTH OF SOME BLUE GREEN ALGAE

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ABSTRACT

Heavy metals (Cobalt and Nickel) were treated with two Cyanophyta species; *Oscillatoria amoena* and *Rivularia* sp. at different concentrations media (5, 10, 20, and 40 ppm of both elements). The effect of Nickel on the growth rate of the two algae was more than that of Cobalt. All concentrations of Ni-ion had fatal effect on the growth rates of the two algae, while the *Rivularia sp.* could have ability to withstand the effect of this ion. The alga *Rivularia sp.* had no growth at the concentration of 20 and 40 ppm of the two metals.

INTRODUCTION

In water bodies, the concentration of various elements may be increased beyond their normal levels due to the releases of; sewage, industrial, agriculture, domestic and other wastes Atte, 2004. Heavy elements are dissolved in water or sorbet to particulate matter and become hazardous to the human health either by drinking water or through food chains. Heavy metals have recently been recognised as important pollutants because they are toxic at low concentrations and accumulated concentrations in organisms more than in the environment. Vymazal, 1990. The factors which influence the element toxicity to algae can be divided into two categories: element chemical speciation and algae physiological resistance (Ndiokwere, 1984). Many studies of water polluted by heavy elements pointed that some elements decreases algal productivity and alter algal species composition Okamura and Aoyama, 1994. Present of some algal species in polluted water could become useful as ecological indicators. Therefore it is important to know the range of tolerance of these species to each element. The algal species are considered to be either sensitive or ressistant, and some of them are intermediate in their tolerance to stress.

These individual tolerances may provide a yardstick for identifying the intensity and potential damage from anthropogenic wastes Genter *et al.*, 1987.

Several authors have recorded a heavy element concentration in various specis of algae and aquatic plants Parry & Hayward, 1973; Munda, 1984; Vymazal, 1987; Abaychi and Al-Obaidy, 1987; Okamura and Aoyama, 1994; Al-Hejuje, 1997. and some of them pointed that micro algae can be serve for the purification of water contaminated by heavy elements.

The aim of this study is to know the tolerances of the two blue green algae species (*Rivularia* sp & *Oscillatoria amoena*) to Ni and Co ions under laboratory conditions.

MATERIALS AND METHODS

Stock cultural preparation: The two blue green filament algae (*Oscillatoria amoena* and *Rivlaria sp)* were collected from Shatt Al-Arab River, isolation and identification were carried out according to Smith, 1933; Prescott, 1975; Hinton & Maulood, 1982; Nurul-Islam, 1982; Al-Handal, 1988; Al-Saboonchi *et al.*, 1990. While purification and mass culturing of those algae were carried out according to Stein, 1973. and modified by Weideman *et al.*, 1984. The procedure was carried out under antiseptic conditions with 32 °C temperature and illumination (White fluorescent tubes, 50-100 µ mol photon m^{-2} s^{-1}). The stock culture was ready for further experiments.

Growth rate: The growth rate was carried out by the estimation of chlorophyll-a contents of the algae, before and after the experiment. Chlorophyll-a, estimation techniques were carried out by extraction of known volume of algal material through millipore filter apparatus, using an aqueous acetone solution (93.5%) as suggested by Furet, 1979. for extracting phytopigments from algal cells. Lastly, estimation of chlorophyll a and phaeophytin a by spectrophotometer was carried out according to Vollenweider, 1974.

Media preparation: The media used each of 250ml, in flasks, according to Watanabe, 1956. Serials of concentrations of Cobalt (Co) and Nickel (Ni) ions were prepared (0, 5, 10, 20 and 40 ppm) of each. Results were taken (0, 3, 6, 9 and 12 days) intervals. Three flask replicates of sample were used in each experiment in addition to the control.

The experiments were carried out under antiseptic conditions with 32 °C temperature and illumination as mentioned before. The results were represented in Tables; 1, 2, 3 and 4.

RESULTS

The growth rate results showed that the highest growth response of *Oscillatoria amoena* was significantly ($p<0.01$) at 10 ppm Co^{++} media after 12 days as compared to the growth rate control, while lowest growth was found at 40 ppm Co^{++} media after same time of the incubation (Table 1). However at 5 ppm and 20 ppm Co^{++} showed the same effect on *Oscillatoria amoena* till the 9^{th} day of incubation.

Table 2 showed that the growth rate of *Rivularia. sp* had markedly high at 10 ppm Co^{++} medium after 12 days of incubation, whereas low growth rate was detected at 40 ppm Co^{++} treatment after 3 days of incubation (Table 2).

Regarding the effect of Nickel ions on the growth rate, the table (3) showed, highest growth rate of *O. amoena* was recorded at the control media (0 ppm Ni^{++} media) after the end of the experiment. The lowest value was recorded at 40 ppm treatment, which showed a complete individual death. The growth at the 10 ppm treatment was more than that of 20 ppm treatment, however, the growth rate had differed significantly ($p<0.01$) within the exposure period.

Table (4) represented the effect of Nickel on the *Rivularia sp,* which give the same pattern on that of *O. amoena*. So, the highest growth rate was recorded at the control media of 0 ppm Ni^{++}. The lowest growth rate was recorded at the media of 40 ppm Ni^{++} after 6 days. While there was no growth rate detected at that media of 40 ppm Ni^{++} treatment.

In the case of the incubation period, highest growth rate was recorded on the 12^{th} day, for both algae fed with 10ppm Co^{++} whereas the lowest growth rate was on the 3^{rd} day that fed 40ppm Co^{++} (Tables 1&2). No significant differences in growth rate were found during the period of 3 to 6 day of incubation. For Ni^{++} treatment, the control of the both algae (0ppm Ni^{++}) gave highest growth rate during the end of the experiment, while the lowest growth rate recorded at 40ppm Ni^{++} for the same period (tables 3&4).

Table 1: Effect of Cobalt on growth of *Oscillatoria amoena*

Time	0 day	3 days	6 days	9 days	12 days
Control	2.458	3.615	6.362	8.73	28.095
5 ppm Co	3.326	3.615	8.73	2.007	9.427
10ppm Co	2.892	2.603	5.205	14.893	34.657
20ppm Co	2.321	2.024	2.024	0.578	1.752
40ppm Co	2.326	1.917	0.868	0.894	0.578

Table 2: Effect of Cobalt on growth of *Rivularia sp.*

Time	0 day	3 days	6 days	9 days	12 days
Control	4.194	4.314	4.458	9.398	16.483
5 ppm Co	4.483	4.169	4.748	6.073	20.531
10ppm Co	4.251	4.917	10.700	16.483	23.827
20ppm Co	4.245	2.169	5.928	4.916	6.217
40ppm Co	4.019	1.446	2.748	4.049	4.916

Table 3: Effect of Nickle on growth of *Oscillatoria amoena*

Time	0 day	3 days	6 days	9 days	12 days
Control	4.048	5.350	6.651	9.254	16.338
5 ppm Ni	4.048	4.193	2.748	2.603	3.326
10ppm Ni	4.230	2.748	2.169	1.446	2.458
20ppm Ni	4.151	1.313	1.880	1.302	1.735
40ppm Ni	4.102	0.723	0.723	0.434	0

Table 4: Effect of Nickle on growth rate of *Rivularia sp.*

Time	0 day	3 days	6 days	9 days	12 days
Control	3.036	1.880	1.880	8.386	15.037
5 ppm Co	3.036	2.458	3.326	6.651	8.964
10ppm Co	3.080	3.759	3.904	10.989	14.893
20ppm Co	3.116	0.723	2.313	3.037	2.024
40ppm Co	3.080	0.434	0.105	0.145	0.145

DISCUSSION

Nickel and Cobalt are, however, micronutrients included into the cell metabolism but they may become toxic when they added in high level to the media e.g. Cobalt blocks the kreb's citric acid cycle and the cellular respiration. Smith and Carson, 1979. The effects of ions of the heavy metals were varied from one species to others, eg. the composition of the cell wall and the cationic and anionic exchange sites in both the cell wall and membrane Munda and Hudnik, 1986.

From tables 1& 2 showed that the effect of Cobalt ions on the growth rate of *O.amoena* was more abundant than that on the growth rate of *R. sp,* but the difference, however, was not significant at $p>0.05$. The ions of Co and Ni may be incorporated in to harmless macromolecules, so, it might be sequester in less mobile organelles and then limiting the access to more sensitive organelles Vymazal, 1990.

The effect of Nickel ions, on the growth rate of *O. amoena* and *Rivularia sp* were more than the effect of Cobalt ions, but this difference was not significant ($p>0.05$). Daday *et al*, 1985. showed that Ni plays role in normal metabolism of N_2-fixing microorganisms by affecting hydrogenase enzyme. Furthermore, Smith and Carson, 1979. explained that Cobalt could substitute for Zn^{++} and active alcohol dehydrogenase, lactate dehydrogenase, alkaline phosphatase, carboxypeptidase and carbonic anhydrase.

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تأثير الكوبلت والنيكل على نمو بعض الطحالب الخضر المزرقة

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الخلاصة

تتركز الدراسة الحالية على تأثير آيونات العناصر الثقيلة (الكوبلت والنيكل) على معدل النمو لنوعين من الطحالب الخضر المزرقه *Rivularia sp, Oscillatoria amoena*، لقد اضيفت تلك العناصر بتراكيز (40,20,10,5) ملغم /لتر الى الوسط الزراعي السائل لمعرفة تأثير تلك العناصر على نموهما. أظهرت النتائج إن تأثير آيونات النيكل على معدل نمو الطحلبين اكثر من تأثير آيونات الكوبلت. وهذا واضح على نمو الطحلب *O.amoena*. كل تراكيز آيونات النيكل تؤدي الى عرقلة نمو الطحلبين. ويبدو ان طحلب *Rivularia sp.* له قدرة على مقاومة تأثير هذه الآيونات. لم يسجل نمو لطحلب *R. Sp* في أوساط 20 و40 جزء بالمليون لآيونين النيكل والكوبلت.