CHROMIUM BIOACCUMULATION POTENTIAL OF EDAPHIC CYANOBACTERIUM *NOSTOC LINCKIA* GROWN ON MULTIMETALLIC SYSTEMS

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Over the past few decades, chromium contamination of both terrestrial and aquatic ecosystems has increased as a result of various anthropogenic activities. In this regard, various useful and practical remediation technologies have been emerging to control chromium content in water, soil and other resources. Chromium remediation through microorganisms may be the best technology currently available for cleaning up Cr contaminated sites. These technologies using biological agents are cheaper, safer and eco-friendly than chemical treatment methods. Cr exists in several oxidation states, but the most stable and common forms are Cr(0), Cr(III) and Cr(VI) species. Chromium toxicity depends on its valence state. *Hexavalent chromium is a* highly mobile and toxic contaminant. Cr(III) being less mobile is much less toxic *than Cr*(VI).

The purpose of this study was to assess the potential of cyanobacterium *Nostoc linckia* to accumulate hexavalent chromium during three successive cultivation cycles on multimetallic systems. Cyanobacterium *Nostoc linckia (Roth) Born et Flah* CNM-CB-03 was grown in a mineral medium and metal ions in different combinations. Cultivation was carried out in Erlenmayer flasks of 1000 mL with a working volume of 700 mL. The following parameters were used: pH of the medium 6.8-7.2, temperature 25-27ºC, light intensity of 37-55 µmol photons m^{-2} s^{-1}, continuous illumination, slow periodic shaking. The amount of inoculum was 0.4 g/L. Each cultivation cycle lasted 12 days. Multimetallic systems Cr/Fe, Cr/Fe/Ni, Cr/Fe/Ni/Zn and Cr/Fe/Ni/Zn/Cu were added to culture medium on the exponential phase of nostoc growth.

In this study, the bioaccumulation of Cr(VI) from multimetallic systems was performed - a situation that is closer to real conditions, since in most cases the contamination of certain areas occurs due to the presence of several pollutants. Among the four studied systems, in Cr/Fe, Cr/Fe/Ni, and Cr/Fe/Ni/Zn/Cu, the rate of chromium uptake by nostoc was very similar and varied with the cultivation cycle. Thus, in these three systems, chromium uptake in the first cultivation cycle was 35.8-40.2% of the initial level of metal; in the second cycle - 27.2-32.7%, and in the third cycle - 19.7-27.1%. In Cr/Fe/Ni/Zn system, the bioaccumulation capacity of nostoc biomass was significantly higher and amounted to 63.1%, 56.0% and 34.8% of Cr(VI), which corresponds to three cultivation cycles. Moreover, Fe, Ni, Zn and Cu were also taken up during the cultivation of nostoc biomass from one cycle to another. For instance, iron uptake in the first cycle was 59-78% and it was accumulated almost completely in the next two cycles. Nickel uptake in the first cycle was 43.2-62.6%, in the next two - 49.7-83.1%. The percentage of zinc recovery by nostoc biomass was at the same level in all three cycles and amounted to 37.1-39.8% of its initial content in the Cr/Fe/Ni/Zn system. In the Cr/Fe/Zn/Ni/Cu system, zinc uptake increased from 25.8% in the first cycle to 54.5% in the third one. Copper uptake was 46.5-57.8%, and its maximum amount was accumulated in the second cycle of nostoc cultivation.

Thus, the culture of *Nostoc linckia* demonstrated resistance to multimetallic systems and a high potential for bioaccumulation of Cr(VI) and other metals present. The capacity of cyanobacterium *Nostoc linckia* to bioaccumulate Cr(VI) from the contaminated medium remained high over three generations, while the uptake of Fe, Ni, Cu and Zn in the biomass increased from generation to generation.

In conclusion, edaphic cyanobacterium *Nostoc linkia* is a good accumulator of chromium, but also of other metals in multimetallic systems. Due to its biological nature, *Nostoc linckia* is a suitable matrix for remediation processes that offers a vast competition ground for metal cations. Therefore, the use of *microorganisms for heavy metal removal* is a sustainable remediation approach that must be adopted in order to balance the environment and nature.