Chapter 6
Bacterial Remediation of Chromium From Industrial Sludge

Dipankar Roy
https://orcid.org/0000-0001-9144-3226
Calcutta University, India & St. Xavier's College, India

Arup Kumar Mitra
St. Xavier's College, India

ABSTRACT

Chromium-like heavy toxic metals seriously influence the metabolism of living organisms and cause permanent threatening of health. Microorganisms can help to detoxify those hazardous heavy metals in the environment by the process of bioremediation. Two bacterial genera were isolated from industrial sludge designated P1 and P2. From the 16srRNA study, it is revealed that P1 is Bacillus cereus *and P2 is* Enterobacter *sp. They are deposited in NCMR and NCBI and received the accession no. MCC 3868 for P1 and MCC 3788 for P2. P1 is gram positive, motile, and P2 is gram negative, motile. Eighteen antibiotics have been taken for antibiotic assay; P1 is resistant to 12; P2 is resistant to 8 antibiotics. For growth pattern analysis in chromium, three parameters have been selected, and they are temperature, pH, and biomass. In LD50 and above parameters, total chromium uptake by those bacteria in stressed conditions have been recorded. The two bacteria are not antagonistic to each other so they are used to bioremediate chromium from their contaminated sites and also treated as consortium.*

INTRODUCTION

Toxic heavy metals are mixing regularly in the environment as a result of industrial activities indicate potential hazard to ecosystem. Toxicants may be inorganic cationic metallic ions of mercury, cadmium, chromium, lead, nickel, Zinc, cobalt etc. Some of the heavy metal are essential and are required by the organism as micronutrient, as known as 'trace elements' [Bruins MR et al., 2000] such as Copper, Zinc

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and Magnesium etc. Heavy toxic metals also seriously influence the metabolism of living organisms and cause permanent threatening of health such as Chromium, Cobalt and Cadmium etc.

Microorganisms can help to detoxify chromium in the environment. By the process of bioremediation those microorganisms are used to remove and recover chromium ions from polluted areas. The process can function naturally or can be improved through the addition of electron acceptors, nutrients, or other factors.

The cost effective and eco-friendly newer biotechnological processes viz. bioremediation through microbial metal reabsorption have been widely accepted.

To overview the mechanisms by which microorganisms interact with heavy metals, and to highlight recent advances in the application of these processes to bioremediation of metal contamination. In order to address the aims of this study, the following objectives were taken into consideration.

ü Isolation of Metal resistant bacteria from industrial sludge.
ü Determination of Chromium content into industrial sludge.
ü Chromium tolerance Study & LD_{50} analysis.
ü 16s rRNA and FAME study for identification of Samples.
ü Study on Morphology, various biochemical character and antibiotic sensitivity of isolated strains.
ü Study of growth patterns and bioaccumulation of samples in different stressed condition.
ü Antagonistic assay of the samples for developing consortium.

BACKGROUND

Among 94 naturally occurring elements only 17 heavy metals have importance for organisms and ecosystems (Weast, 1984). Among these elements, Al, Co, Se, and Si play a role in promoting plant growth and may be essential for particular taxa. Cobalt is an essential trace element that is an integral part of vitamin B12, which is essential in the metabolism of folic acid and fatty acids. Tungsten (W), on the other hand, appears to be essential only in hyperthermophilic bacteria, *Pyrococcus furiosus*, found in hydrothermal vent. However, elevated concentration of both essential and nonessential metals can result in growth inhibition and toxicity symptoms. For Example: Lead interferes with haemoglobin formation and causes anaemia due to deficiency of haemoglobin. Lack of haemoglobin may further cause kidney and brain damage. Cobalt may cause nausea and vomiting, deafness, nerve problems, ringing in the ears (tinnitus), thickening of the blood, thyroid problems. Enzymes like catalase, peroxidase and cytochrome oxidase with iron as their component are affected by chromium toxicity (Nath *et al.*, 2008).

There are a variety of natural and anthropogenic sources of heavy metals in the environment. On a worldwide basis, the disposal of commercial products that contain chromium may be the largest contributor, accounting for 51% of the total chromium released to soil (Nriagu and Pacyna 1988). Other significant sources of chromium release into soil include the disposal of coal fly ash and bottom fly ash from electric utilities and other industries (33.1%), agricultural and food wastes (5.3%), animal wastes (3.9%), and atmospheric fallout (2.4%) (Nriagu and Pacyna 1988). Solid wastes from metal manufacturing constituted >0.2% to the overall chromium release in soil. It is estimate that the total emission of chromium to the atmosphere is about 1.92×10^5t.

From polluted environment several techniques are there to remove or recover chromium such as adsorption processes, electrochemical techniques, ion exchange, reverse osmosis, chemical precipitation,