Chromium Bioremoval by Staphylococcus sp. and Pseudomonas sp. Isolated from Industrial Waste Water in Baghdad, Iraq

Faiza Kadhim Emran¹, Hazim A. Walli², Tha’ir Abid D’asheesh³,Fadhaa Jaber Shinjar ⁴, Mustafa Ali Abdulameer ⁵
¹Department of Biology, College of Science, University of Baghdad, Baghdad, Iraq
²,³,⁴,⁵ College of Science, University of Al – Qadisiyah .Iraq
Email : faizakadhim@scbaghdad.edu.iq

Abstract .Five samples were accrued beside the wastewater of State Electrical Manufacturing Company between Baghdad/Iraq, as much triplicates. Biological absorption can remain an high quality approach because treating severe humor wastewater beside chromium produced by using humus then manufactured activities. Many bacteria Gram-positive & Gram-negative have the ability after remove chromium and as a result redact guilty water free. In this study, the chromium biosorption the usage of single and blended subculture concerning microorganism reduced such as like Staphylococcus sp. and Pseudomonas sp. The parameters used to be measured on biosorption regarding chromium; certain as much time, pH, temperature have been examined. This study indicates so 28.5% beyond biosorbent aggregate beyond chromium combined cultures on Pseudomonas sp. hold been celebrated or Staphylococcus sp, 10.4% & 13.5% biosorption because single cultures respectively. The age in imitation of achieve most adsorption about chromium was 159 mg/l then 24 hours because mixed isolates from Pseudomonas sp. And Staphylococci. The most advantageous biomass awareness was once 0.5 mg/ml for mixed isolates, Pseudomonas sp. and Staphylococci. PH 5 used to be found according to be optimized because all ternary biomass (two unaccompany isolates; one combined isolation) because chromium biosorption. The most beneficual temperature was once 50 ° C because whole three structures ancient into the present work.

Keywords: Chromium, bioremoval, pseudomonas, staphylococcus, wastewater, Baghdad, Iraq

1. Introduction

Heavy metal ions Presence into natural stream lotus is a coherent environmental trouble prompted by using the release of manufactured wastewater. Heavy metal ions are frequent pollutants on big environmental subject as they are non-degradable yet hence chronic into disposition as accumulates among the food chain, which along time reach harmful ranges within living systems, resulting into big fitness risks certain as much inflammation between liver and stomach, cancer between digestive tract, vile increase costs of flowers then loss of life on animals durability (Orozco et al., 2008). Chromium is a geochemical component over anthropogenic groundwork or is widely dispersed into rocks, minerals soils, and sparkling water. The joining typical oxidative shapes regarding chromium into the surroundings are hexavalent Cr (VI) then trivalent Cr (III) so hold greatly contrasting toxicity or transit characteristics: hexavalent chromium is greater poisonous with excessive lotus solubility or...
mobility, while trivalent chromium stability is less soluble of water, less cell then harmful toughness (Chojnacka, 2010). Nutritionally, Cr (III) is an fundamental factor about a coherent ethnical then animal meals for resistant negative consequences into the danger over glucose or lipids. Although Cr(III) in little aggregation is an essential nutrient wanted with the aid of the body, absorbing large quantities of Cr (III) can also additionally reason fitness evils e.g. lung cancer (Costa, 2003). Beginning deficiencies then the decrease concerning reproductive health that metal might also effect loss of life among animals and humans, salvo swallowed of high doses (Marsh and McLnerney, 2001). Ecofriendly procedures need in imitation of lie technologically superior in accordance with cleansing the environment without producing hazardous waste byproducts toughness (Ahmad et al., 2010). Biosorption tactics are very fantastically among contrast to physicochemical techniques for Cr(VI) removal due to the fact he are less highly-priced and tremendously high-quality too at many severe metallic concentrations, both living and non-living microbial biomass are authority over receiving on metal ions beyond aqueous solution. toughness stability (Ahluwalia, 2013). The aim of this study is to capabilities of gram negative Pseudomonas sp. and gram positive Staphylococcus sp. that isolates from electrical waste water state of the chromium biosorption and investigation the best isolate to Chromium heavy metal biosorption and studying the factors that affect the biosorption process and capabilities of combined Pseudomonas sp. and Staphylococcus sp. cell surfaces in chromium biosorption.

2. Material and methods

2.1. Preparation of chromium solutions

Metal solutions prepared permanency by dissolving K₂Cr₂O₇ into doubled distilled water after reach a stock solution on a 1000 mg/L. The metal solutions organized between sterilized glassware and the glass ware defended including 0.1 M HCl earlier than or afterwards the biosorption experiments after eliminate binding regarding metals in accordance with it.

2.2. Sampling

Five water samples (one sample per week, as triplicates) in a volume of 1 litter were collected from the main tank in the industrial wastewater treatment unit in Electrical State for the period of January 24th to March 25th, 2018, in sterile glassware containers. Each sample was divided into two parts; the first set was gained to evaluation the temperature, pH and chromium concentration, while the other set was collected for bacterial isolation. Temperature, pH and chromium concentration of water samples were estimated in situ. The temperature was measured by a thermometer at (15-20) cm depth. PH was measured using a portable pH meter. The samples were digested by Digester (Buchi 430, Germany) after to estimate the total chromium (APHA, 1998).

2.3. Isolation and identification of bacteria:

All samples were cultured by streaking on MacConkey agar, nutrient agar and blood agar, and incubated at 37 ºC. After 24 hrs. The results were noted and the grown colonies were exposed to microscopic examination and biochemical tests in order to identify them according to 2nd edition of Bergey’s manual(Garrity et al 2004).

2.4. Preparation of Biosorbents:

Bacterial isolates were spread in brain heart infusion broth pH 7.2 incubated at 37°C for 24 hr. Then growing cells were collected by cooled centrifugation (4 ºC) at 5000 rpm for 30 min. At that moment, washed with deionized distilled water (DDW) three times, collected in sterile test tubes and re
suspended in small amount of DDW. One millilitre was dried in the oven at 100 °C in order to estimate the dry weight.

2.5. Analytical Estimation of Chromium

Chromium concentration calculated with the aid of the aggregate of the color complex made used to be modest the usage of a UV-visible spectrophotometer. The absorbance was once adequate in opposition to a test clean at 540-nm wave maximum. A linear intend was taken showing honour in conformity with the Beer Lambert's regulation between the concentration length studied.

% Biosorption = (Initial - Final metal concentration) \* 100 \/(Initial metal concentration).

3. Result and discussion

3.1. Effect of pH

The pH value of this study is an important factor that regulate the sorption of Chromium. Figure 1 shows the highest pH for biosorption efficiency was pH 5. The highest value biosorption recorded in 90.68% at pH 5 while the lowest value was recorded in 15.19% at pH 1. The best biosorption pH observed in this study that pH 5 from both bacterial isolates *Pseudomonas* sp. and *Staphylococcus* sp.

![Figure1](image_url)

*Figure1*: Effect of pH on biosorption chromium concentration in wastewater for *pseudomonas* sp. and *staphylococcus* sp.

pH regulates the speciation and solubility of toxic metal ions and also affects the properties of the biomass (Chen *et al*., 2008). Several hard metals appear so authorized hydrated species at decrease pH, hydroxides are instituted along increasing pH or sooner or later precipitation may also occur. pH influences the magnitude of negative charge on the surface of the material by either protonation or deprotonation of metal-binding sites. The various pH sorption shapes for a range of difficult steel ions can also be associated in conformity with the behavior over chemical exchanges about each metallic along biomass longevity toughness toughness (Bueno *et al*., 2008).

3.2. Effect of temperature

Chromium biosorption effected by temperature, this obtain in Figure 2. Best biosorption was observed 70.16% at 50 °C, while the lower was observed 15.8% at 10 °C. *Pseudomonas* sp. Shows best biosorption in 50 °C rather than *Staphylococcus* sp. In these research there was an increase in biosorption with increase in the temperature but there was a slow decrease with further increase in...
temperature. This is because of the shrinkage of cells in the higher and lower temperatures which decreases the surface area of contact.

![Figure 2: Effect of temperature on percent Chromium biosorption for pseudomonas sp. and staphylococcus sp.](image)

Biosorption in nature then as a result the degree about it processes will expand together with enlarge among the temperature. However, at high temperatures, cell walls partitions can also stay early and late then because of that purpose amplify among metal apprehension is observed. Most of the increase in uptake has been reported in the high temperature by biomass. The metabolism of living cells is temperature dependent, and hence change in this parameter will strongly affect the biosorption processes (Bueno et al., 2008).

### 3.3. Effect of contact time

The biosorption experiments of Chromium were carried out for different contact times with a fixed adsorbent dose of 100 mg/ml concentration at pH 5 and at 50 C. The results were plotted in Figure 3. The biosorption percentage of metal increased with increase in contact time. The equilibrium time was 24 hours for Chromium (96%).
Biosorption studies on Chromium using mixed cultures of *Pseudomonas* sp. and *Staphylococcus* sp.

Current study covenants the utilization of mixed cultures of gram positive and gram negative bacteria as biosorbent for the sorption of Chromium. As the advantage of both bacterial isolates in biosorption studies on Chromium sorption using this mixed biomass were done. The effect of biomass concentration on sorption of Chromium was studied using 0.5 mg/ml. These studies were done at a fixed pH 5, 50°C for 24 hours. From this we can conclude that best biosorption for Chromium with mixed cultures of *Pseudomonas* sp. and *Staphylococcus* sp. (1:1) this shows in figure 4.

**Figure 3:** Effect of time on percent Chromium biosorption for *Pseudomonas* sp. & *staphylococcus* sp.

**Figure 4:** Effect of Chromium biosorption at 50°C for 24 hours, pH 5 for *Pseudomonas* sp. & *Staphylococcus* sp. and mixed culture (1:1)
The total on a biosorbent intensely outcomes the extent about biosorption. An enlarge into biomass attention commonly increases the total about solute biosorbed due to the increased surface area of the biosorbent, which in turn increases the number of binding sites (Ziagova et al., 2007). Conversely, the sum on biosorbed solute care of soloist ponderosity regarding biosorbent decreases with an increasing biosorbent dosage, which may also stand due in accordance with the complex interaction on several factors. An vital issue at excessive sorbent dosages is up to expectation the reachable solute is unsatisfactory in conformity with totally cowl the available exchangeable web sites concerning the biosorbent, normally ensuing within mangy solute uptake The interference between binding sites due to increased biosorbent dosages and this will result in low specific uptake (Bueno et al., 2008).

4. References

[1] Orozco, A.M.F., Contreras, E.M., and Zaritzky, N.E. 2008. Modelling Cr(VI) removal by a combined carbon-activated sludge system. Journal of Hazardous Materials 150, 46-52.
[2] Chojnacka, K. 2010. Biosorption and bioaccumulation the prospects for practical applications. Environment International 36, 299 307.
[3] Costa, M. 2003. Potential hazards of hexavalent chrome in our drinking water. Toxicology Applied Pharmacology 118, 1 5.
[4] Marsh, T.L. and McNerney, M.J. 2001. Relationship of hydrogen bioavailability to chromate reduction in aquifer sediments. Applied and Environmental Microbiology 67(4), 1517-1521.
[5] Ahmad, W.A., Zakaria, Z.A., Khasim, A.R., Alias, M.A., and Shaik Ismail, S.M.H. 2010. Pilot-scale removal of chromium from industrial wastewater using the ChromeBac system. Bioresource Technology 101, 4371–4378.
[6] Ahluwalia, S.S. and Goyal, D. 2013. Microbial waste biomass for removal of chromium(VI) from chrome effluent bioremediation Journal 17(3), 190-199.
[7] American Protection Health Agency (APHA). 1998. Standered methode for examination of water and waste water 20th Ed.
[8] Garrity, G., Brenner, D., Krieg,N., and Staley, J. 2004. Bergey’s manual of Systematic Bacteriology, Second Edition. Springer.
[9] Chen, G., Zeng, G., Tang, L., Du, C., Jiang, X., Huang, G., Liu, H., and Shen, G. 2008. Cadmium removal from simulated wastewater to biomass byproduct of Lentinus edodes. Bioresour. Technol. 99:7034–7040.
[10] Bueno, B. Y. M., Torem, M. L., Molina, F., and de Mesquita. L. M. S. 2008. Biosorption of lead (II), chromium (III) and copper(II) by R. opacus: equilibrium and kinetic studies. Miner. Eng. 21:65–75.
[11] Ziagova, M., Dimitriadis, G., Aslanidou, D., Papaioannou, X., Tzanetaki, E. L., and LiakopoulouKyriakides, M. 2007. Comparative study of Cd (II) and Cr (VI) biosorption on Staphylococcus xylosus and Pseudomonas sp. in single and binary mixtures. Bioresour. Technol. 98:2859–2865.