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# Effect of heavy metals to bacterial culture and the removal of heavy metals from an industrial effluent

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**ABSTRACT**

This paper reports the capability of consortium culture (CC) comprising of an acclimatized mixed bacterial culture to withstand the toxic effect of Cr(VI), Cu, and Pb, at 1, 10, 100 mg/l and its uptake, and to remove heavy metals from an industrial effluent. Consortium culture displayed good heavy metal resistance (75-84.6%) on nutrient agar. Inverse of heavy metal toxicity index, B (l/mg) reflected CC's ability to tolerate Cr(VI) concentration of up to 507.6 mg/l, followed by Pb at 348.43 mg/l and Cu at 243.90 mg/l. High metal uptake capacity was observed at 1 mg/l (q = 4.47-10.33 mg/g), 10 mg/l (q = 29.27-96.07 mg/g) and 100 mg/ (q = 85.28-175.02 mg/g) in nutrient broth. Overall, metal toxicity was in the order Cu > Pb > Cr(VI), and metal uptake was Pb > Cu > Cr(VI). X-ray fluorescence screening indicated the abundance of Ca, K, P, and S on the biomass. Heavy metal removal study demonstrated that CC was able to grow in waste effluent which was not subjected to any pre-treatment or nutrient addition. Significantly higher metal removal in the range of 92-97.5% ($P < 0.05$) was obtained for Cd, Cr(VI), Cu, Ni, and Pb with CC. Furthermore, CC was able to thrive and compete in the presence of indigenous microbial population with no apparent decrease in metal removal capability. In conclusion, results establish the feasibility of employing CC to remove heavy metals from industrial effluents and support the development of a bacterium-based integrated waste treatment system.

**Key words:** Consortium culture, metal removal, metal resistant, metal uptake, industrial effluent, waste treatment.

## INTRODUCTION

Heavy metal pollution in the environment is of great concern to scientists as well as environmentalist as metallic ions are known to be recalcitrant in nature and non-biodegradable as opposed to many other xenobiotic compounds. The phenomenon of environmental pollution is a global issue nowadays. Heavy metals generally refer to metals exhibiting > 5 g/cm$^3$ in atomic density and usually known for its toxicity and associated with pollution (Nies, 1999). Its presence in potable waters is potentially hazardous to health. The main generator of heavy metal containing waste are the metal finishing and plating, metallurgical works, film processing, electrical and semiconductors, agriculture (fertilizer, pesticide, fungicide), petroleum and gas operations, and from the combustion of fossil fuels (Doble and Kumar, 2005). In Malaysia, the implementation of strong industrial plans towards achieving vision 2020 to become a developed nation has seen the establishment of various industrial estates to drive the manufacturing sector. However, the same emphasis cannot be said in aspects relating to industrial waste and effluent treatment, and management. Major water pollution point sources are mainly from the sewage treatment plants (48.3%) and manufacturing industry (45.1%) (Malaysia Environmental Quality Report 2007, 2008). Monitoring of the environmental regulation compliance by local enforcement agencies showed that industries like metal finishing and electroplating,